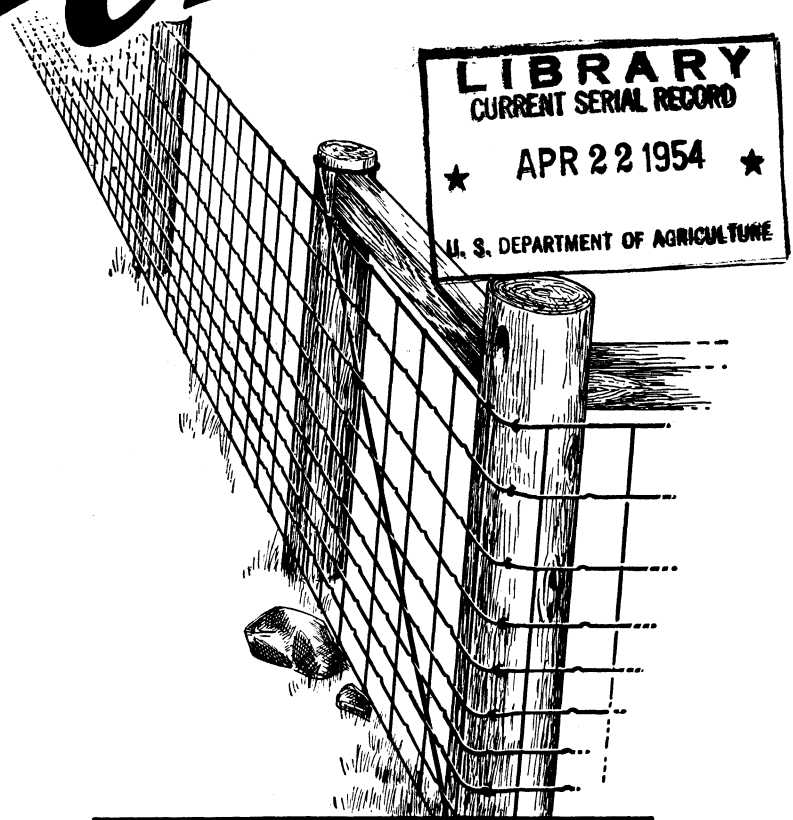
FARM Fences



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Farm Fences

By EDWARD G. MOLANDER, *senior agricultural engineer, Agricultural Engineering Research Branch, Agricultural Research Service* [1]

DEVELOPMENTS in the methods and materials used in this country to construct farm fences have been made to keep pace with other developments in agricultural production. Colonial farmers fenced with stones and rails, and sometimes made fences by piling the uprooted stumps of trees in tangled rows. Hedges were also used as fences by colonial farmers—George Washington's interest in hedge fences led him to import several species of shrubs and trees. Interest in living fences has persisted to the present time; multiflora rose is one of the most popular plants now used for this purpose. For more detailed information about this shrub, see Leaflet 256, Multiflora Rose for Living Fences and Wildlife Cover, available from the Office of Information, United States Department of Agriculture, Washington 25, D. C.

The invention of machinery to manufacture steel wire at low cost resulted in drastic changes in farm fencing. Wire fences replaced stone and rail fences to a large extent, and also made it possible for stockmen to employ fewer cowboys and sheepherders than were needed when fencing costs were prohibitive. Other developments which made it possible for the modern farmer to have durable fences at reasonable cost are steel posts and chemicals for preserving wood posts. The electric fence has been widely accepted as a convenience in temporary fencing of rotation pastures and annual crops where permanent fencing would be expensive and perhaps not wanted.

High-speed traffic on highways has created a hazard which many farmers have had to solve by designing special gateways in fences around fields and farmsteads. Contour farming is another development which has introduced new problems that require special methods of fence construction.

Kinds of Fences

The decision on the kind of fence to build should be made after considering such factors as land value, the kind of crops grown, the kind of machinery to be used, and availability of labor for maintenance. In marginal, cut-over, or low-priced land, the unit cost of fencing is of more importance than the type. If the land is valuable the fence should occupy as little space as possible. Fences around cultivated row crops require wider strips than fences around hay or grain crops, because implements used in row crops must have a strip for turning, whereas a mower or binder can cut close to the fence line. Woven-wire or smooth-wire fences require less turning space than do barbed-wire fences.

Stone, hedge, and rail fences require strips of ground ranging from 6 to 10 feet or more. Little land

[1] Revision of a previous edition by M. A. R. Kelley (deceased), formerly agricultural engineer, Division of Farm Buildings. Special acknowledgment is made to Prof. Henry Giese of Iowa State College, who supplied much of the information on fence erection and corner bracing presented in this bulletin.

is wasted where pastures or orchards are divided by wire fences. The cost of trimming hedge fences and keeping them clear of brush and weeds is high, and the cost of clearing brush and weeds from stone and rail fences is also high. Two other factors which are important in determining the kind of fence to build are the type of livestock to be confined and the availability of materials.

The laws of most States define what constitutes a legal partition fence, or a fence along a highway or railway.

Rail Fences

The zigzag, worm, or Virginia rail fence (fig. 1, *A* and *B*) as it is variously named, is found in most States east of the Missouri River and in some of the Western States. When well built on a solid footing it is substantial, and where labor and wood are plentiful it makes a cheap fence. It is used as a temporary fence since it may be moved as the fields are cleared or extended. This type of fence is built 6 to 11 rails high. Braces or stakes must be used to hold the rails in place and to give the fence stability. The rails are usually 11 feet long and are laid at an angle so that each rail advances the fence 8 feet. A width of base of 4½ to 5 feet is necessary for the fence to withstand high winds. The heaviest rails are placed on top to give added weight and to reduce the number of rails broken by people climbing the fence.

Straight fences are also built of rails (fig. 1, *C* and *D*). Straight rail fences require fewer rails, are easier to keep clean, and cover less ground than the zigzag form.

Board Fences

Many board fences are found in Virginia and Kentucky, particularly where horses are raised extensively. When painted white or whitewashed, such fences make an attractive framing for a farmstead. The boards and fences are sometimes creosoted for durability.

Planks well spiked or bolted to substantial posts make a safe fence for a paddock or barn lot (fig. 2, *A*). Planks should be on the paddock side of the post so stock will not loosen them. One-inch boards 6 or 8 inches wide are also used for fencing. They should be nailed on with tenpenny galvanized or cut nails, which last longer than common wire nails and are less likely to split the board. Four to six boards are commonly used per panel.

The boards in the fence shown in figure 2, *B* are held in place by cleats. The cleats are fastened to the posts by sixtypenny spikes which are driven through holes bored in the cleats. The cleats may be easily loosened and the boards removed in case of fire. The double board at the bottom lessens the danger of injuries to horses' legs. Cleats and post caps (fig. 2, *C*) are often used with light boards. For paddocks a cap board extending from post to post is sometimes used.

Stone Fences

Stone fences are as varied in design as the kinds of stone available for their construction. They range in height from 3½ to 5 feet and are made with flat stones, quarried stone, or with field boulders. Stones may be laid loose or with mortar joints. Considerable skill is required to lay a loose-stone fence because it is difficult to properly tie and chink the large stones with small ones. Round-shaped stones should probably be laid with mortar joints. All stone fences should be built on a substantial and well-drained foundation. Various styles of construction for stone fences are shown in figure 3.

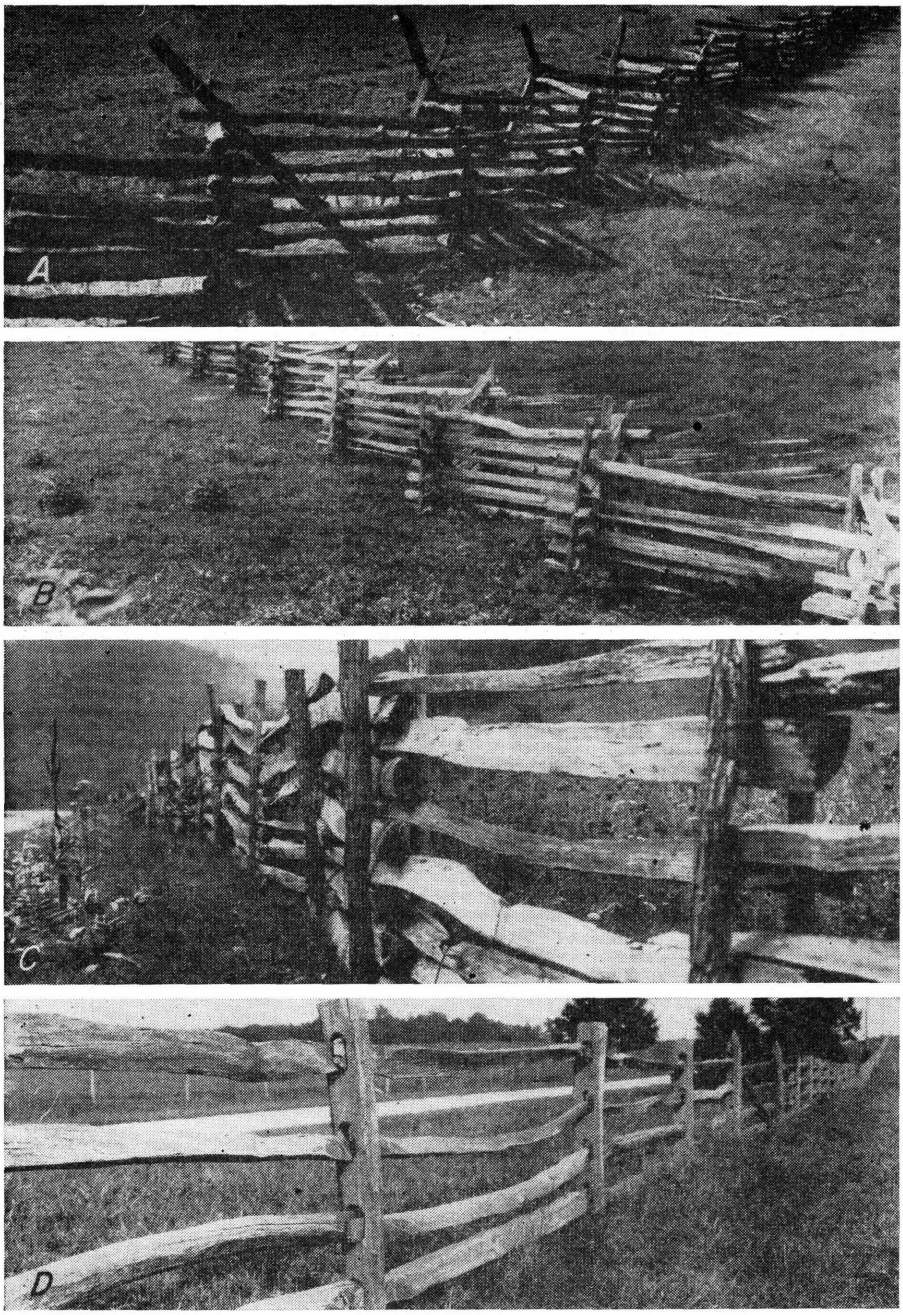
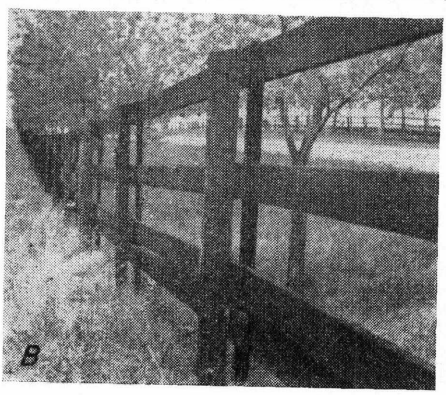


FIGURE 1.—*A*, A zigzag rail fence having diagonal braces; *B*, a zigzag rail fence with stakes in the corners; *C*, a straight rail fence with stakes driven and wired together; *D*, a straight rail fence made by inserting the ends of chestnut rails into mortised posts. Concrete posts may be used in place of the mortised wood posts.



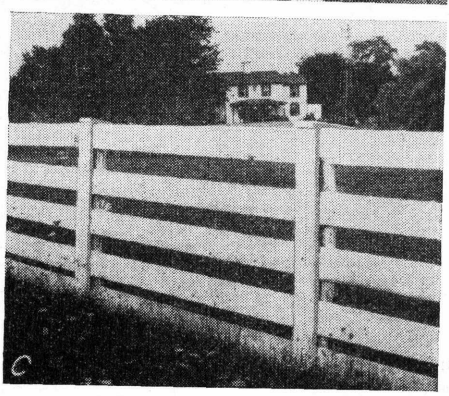


FIGURE 2.—*A*, A substantial plank fence with joints on alternate posts; *B*, a board fence and posts treated with creosote—boards are removable; *C*, a 5-board fence with cleat boards and post caps.

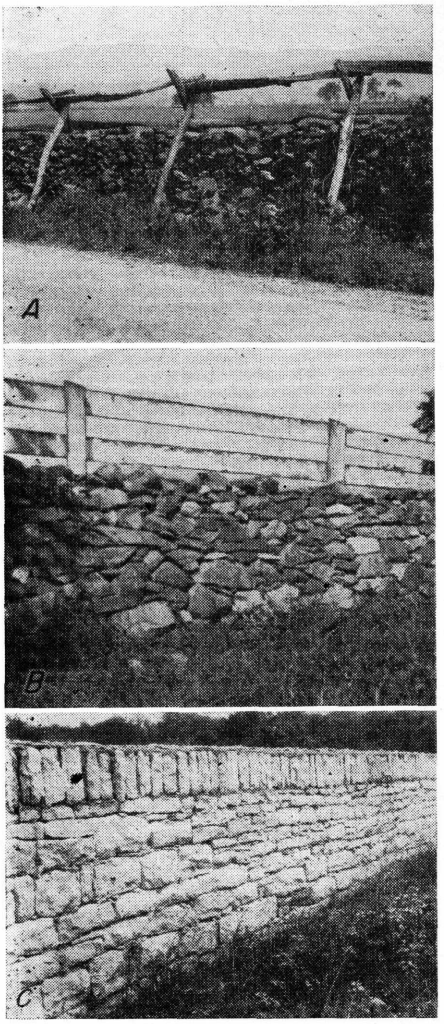


FIGURE 3.—*A*, A fence of loose stones with stakes and riders to increase the height; *B*, a combination board and loose stone fence; *C*, a fence of limestone with an occasional mortar tie and a top dressing.

Steel Wire Fences

The most important types of farm fences are barbed wire, woven wire, or a combination of both. In order to reduce cost and to insure durability, manufacturers and representatives of consumers have cooperated with the Federal Government in setting up certain standards for the manufacturing of steel-wire fencing. These standards reduce considerably the number of styles of fencing and sizes of wires previously used, and also provide the requirements for a protective coating of galvanizing. These standards are given in table 1.

TABLE 1.—*Gage number, diameter, and weight of zinc coating of steel wire used in farm fencing*

Gage No.	Diameter	Weight of zinc coating per square foot of wire surface	
		Minimum	Maximum
	Inches	*Ounces*	*Ounces*
9	0. 1483	0. 40	0. 70
10	. 1350	. 30	. 60
11	. 1205	. 30	. 60
12½	. 099	. 30	. 60
13	. 0915	. 30	. 60
14	. 0800	. 25	. 55
14½	. 076	. 20	. 50
15½	. 067	. 15	. 40

All iron rusts in moist air unless protected. Early manufacturers used red paint or lacquer to prevent corrosion, but now galvanizing (coating with zinc) is the principal protection used. Good zinc is one of the best coatings known.

Barbed Wire

There are five standard styles of barbed wire and one standard style of two-strand twisted barbless wire. Styles of barbed wire differ in the shape and number of points of the barb, spacing of the barbs, and size of wires. Selection is generally a matter of personal preference. Table 2 presents information on barbed and barbless wire.

Barbless wire is used in southern areas for cattle fencing because there is danger of screwworm flies laying eggs in the open wounds which are sometimes inflicted by barbed wire. Barbless wire is also used for horse enclosures.

TABLE 2.—*General specifications for galvanized barbed and barbless wires used for farm fencing*

Number and shape of barbs	Spacing of barbs	Gage of barbs	Gage of strand wire	Weight per 80-rod roll
	Inches	*No.*	*No.*	*Pounds*
2 points, round	4	14	12½	79¼
2 points, round	4	16	14	51½
4 points, round	5	14	12½	86½
4 points, half-round	5	[1] 14	12½	81½
2 points, flat	4	[1] 12½	12½	77
Barbless			12½	69

[1] The gage of the half-round and flat barbs is the same as that of the full-round wire section from which the barbs are made.

Barbed wire is sold in spools of 80 rods. Farmers are interested in the price for a given length of wire, but weight is important in determining wire values because heavier wires last longer. Weight should be considered when wire is purchased. All spools should have tags showing weight as well as length.

Figure 4 illustrates a well-built barbed-wire fence with five lines.

Fence stays are sometimes used between posts in barbed-wire fencing. They hold wires at the proper spacing and the posts may therefore be spaced slightly farther apart. Stays may be made of wood slats or twisted wire.

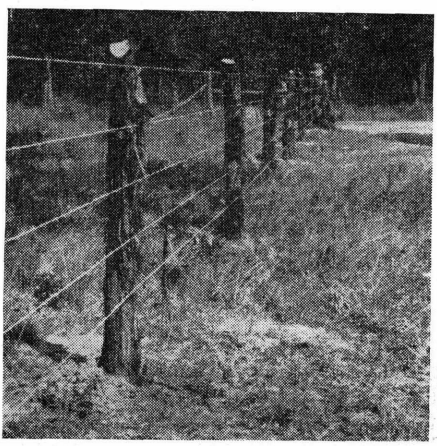


FIGURE 4.—A well-built barbed-wire fence with five lines of wire on cedar posts. This fence is suitable for cattle.

Woven Wire

Rectangular-mesh wire with hinge joints (fig. 5) is the type of woven wire most commonly used for field fences. Single and double loop, full or half hexagon, or slight variations are used for paddocks, lawns, gardens, and poultry yards. The close-mesh rectangular, diamond, or chain-link types are used for nonclimbable guard fences and for lawns.

There are eight principal standard types of woven-wire field fences. The most commonly used are shown in figure 5 and are numbered 1155, 1047, 939, 832, and 726. The first 2 digits in the style numbers having 4 digits, and the first digit in the style numbers having 3 digits, represent the number of horizontal wires in the fence. The last two digits represent the height in inches. For example, style No. 1155 has 11 horizontal wires and is 55 inches high. Standard woven-wire field fencing is sold in rolls of 20 rods. Three other types numbered 949, 845, and 635 are the same as 1155 except that in 949 two bottom wires are omitted, in 845 three bottom wires are omitted, and in 635 five bottom wires are omitted.

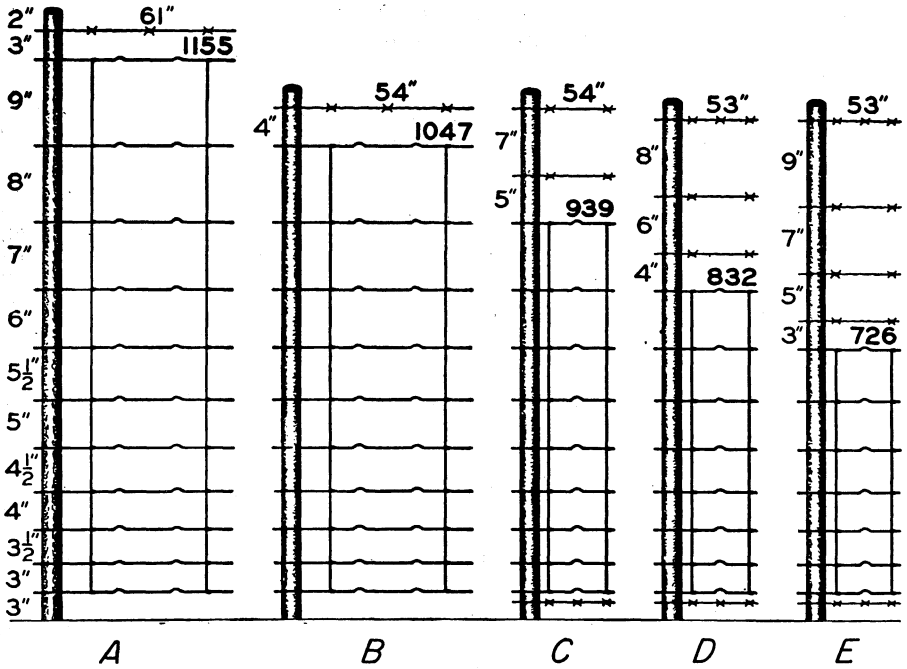


FIGURE 5.—Standard types of woven-wire fencing combined with barbed wire: *A*, Fence with a single barbed wire and woven wire 55 inches high with 11 horizontal wires and 12-inch spacing of stays; *B*, identical to *A* except woven wire is 47 inches high; *C*, *D*, and *E* show other combinations of barbed wire and woven wire, with 6-inch spacing of stays in the woven wire and a bottom line of barbed wire for hogs.

In standard field fencing the vertical stay wires are spaced 6 or 12 inches apart; the stay and intermediate line wires are the same size and are 11, 12, or 14½ gage; and the top and bottom wires are 9, 10, or 11 gage. The standard specification numbers of woven-wire fences are the same as the gage number of the stay wire used in the fence, as is shown in table 3.

Fencing which is manufactured under the specification numbers given in the table meets all ordinary farm requirements. The heavier wire gives longer service and has lower maintenance costs, because light wire has greater surface area per pound of wire and is more subject to corrosion. Stay wires are made stiff or flexible, and both forms are made by most manufacturers. Flexible stays absorb shocks more readily while the stiff stays tend to keep the fence more erect.

TABLE 3.—*Gages of top, bottom, intermediate line, and stay wires in woven-wire fences of standard specification numbers*

Specification number	Gage	
	Top and bottom wires	Intermediate line wires and stay wires
	No.	*No.*
9	9	9
11	9	11
12½	10	12½
14½	11	14½

Tension curves are a feature of good woven-wire fencing. These curves are built into the line wires for the purpose of providing for contraction and expansion due to temperature changes. These curves

are in some cases offset as much as three-eighths of an inch and are spaced 6 inches apart (fig. 5). They serve as a guide to the amount of tension applied when the fence is stretched. Stretching is discussed, page 32. If the wire is of high quality and not excessively stretched it will expand and contract with temperature changes without becoming permanently elongated.

Figure 6 illustrates a well-built, woven-wire fence; figure 7 shows how a fence may be crowded down by stock when the top strand of barbed wire is omitted.

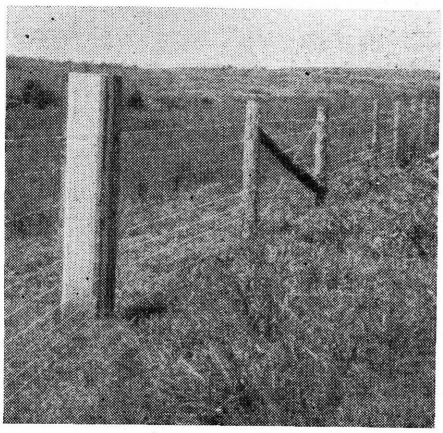


FIGURE 6.—Braced line posts, such as the one shown at the right in this picture, give support to several rods of the fence line on each side of it. Where there is a slight angle in the fence a concrete anchor post, such as the one shown at left in the picture, may be set to prevent the wire from pulling posts out of line.

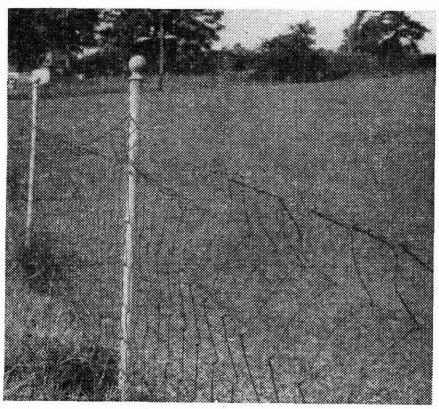


FIGURE 7.—This woven-wire fence was crowded down by stock because the top line of barbed wire was omitted.

Poultry Fencing

Sanitation is an important step in successful poultry production, and fencing is of prime importance in the maintenance of sanitary conditions about pens and houses. Poultry fencing can be used to separate diseased birds from healthy birds, breeding stock from the laying flock, chicks from older birds, and pullets from hens. Wire fabric or netting is used for sun parlors, floors, and roosts.

There are 2 standard types of poultry fencing, numbered 2158 and 1948, and 3 standard types of chick fencing, numbered 2672, 2360, and 2048 (fig. 8). Vertical stay wires in these fences are 6 inches apart, the filler wires (stay and intermediate line wires) are 13, 14½, or 15½ gage, and top and bottom wires are 11 or 12½ gage. The fencing is sold in 10-rod rolls. Specifications for standard poultry and chick fencing are given in table 4.

TABLE 4.—*Specifications for poultry and chick fence*

Design No.	Height	Gage of top and bottom wires	Gage of filler wires
	POULTRY FENCE		
	Inches	*No.*	*No.*
2158–13	58	11	13
1948–13	48	11	13
2158–14½	58	11	14½
1948–14½	48	11	14½
	CHICK FENCE		
2672–14½	72	11	14½
2360–14½	60	11	14½
2048–14½	48	11	14½
2360–15½	60	12½	15½
2048–15½	48	12½	15½

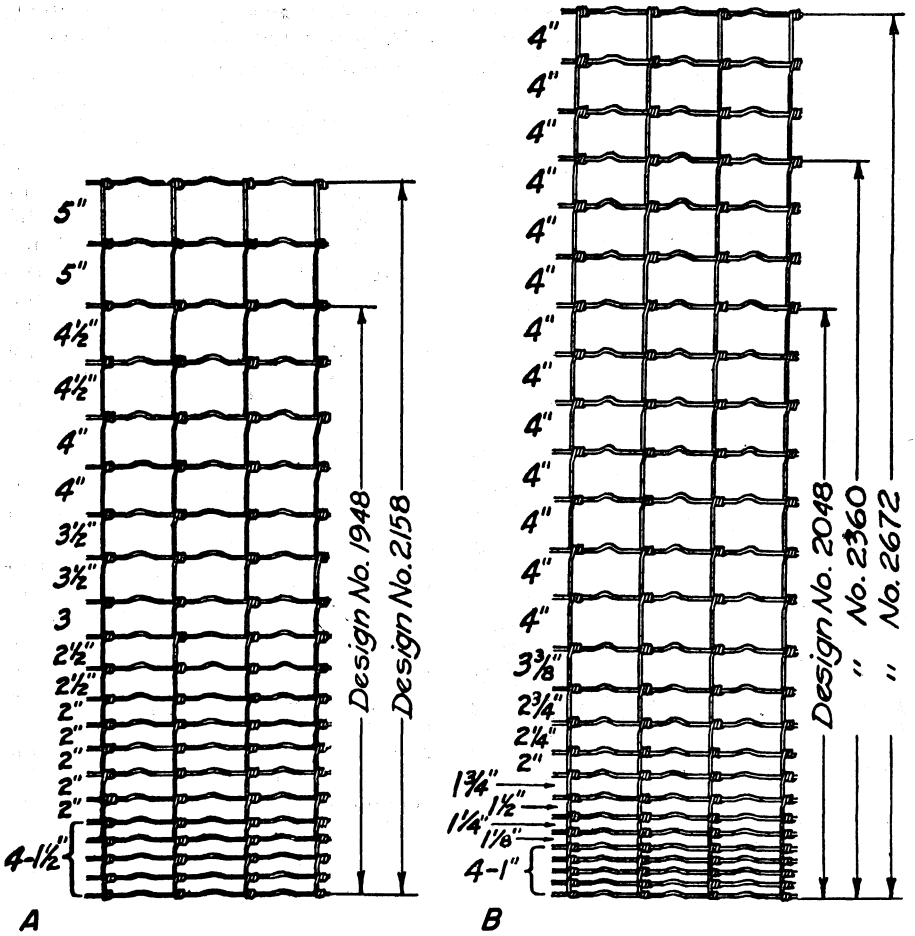


FIGURE 8.—*A*, standard styles of poultry and garden fence; *B*, standard styles of chick fence. The first 2 numbers in the style number indicate the number of horizontal wires in the fence, and the last 2 numbers indicate the height in inches.

Fencing for heavy breeds may be 48 or 60 inches high, but for lighter breeds a height of 72 inches is preferable. A single wire placed on a bracket inside of the pen and above the wire netting is effective in discouraging birds from flying out of the pen.

Galvanized poultry netting is made with 1- or 2-inch hexagonal mesh and in 9 heights ranging from 12 to 72 inches. Netting serves for a short time for small poultry yards and small back yards, but fencing with heavier wires has a longer life and gives more satisfactory service.

Wire Fences for Special Needs

The choice of a fence should be determined by the type and size of the farm. Horses, cattle, hogs, sheep, and poultry are found in all parts of the United States, but the relative importance of each class of animal varies. In the Corn Belt, horses, cattle, sheep, and hogs may be found on a farm, and sometimes even in a single pasture. A high woven-wire fence such as that shown in figure 5, *A* and *B* is commonly needed in that area. Woven-wire fences 26 inches high with 4 barbed

wires above (fig. 5, *E*), and 32-inch woven-wire fences with 3 barbed wires above (fig. 5, *D*) are also common. Construction costs for the two types shown in figure 5, *D* and *E*, are about the same, but the upkeep for the type shown in figure 5, *D* is less. Either type is satisfactory for sheep.

Hog fences are usually made with a combination of woven wire and barbed wire. The kind of fences shown in figure 5, *C*, *D*, and *E*, but without barbed wire above the woven wire, are commonly used for hogs. A barbed wire 2 or 3 inches above the ground is used for fences around permanent pastures to discourage rooting. A temporary fence of woven wire without barbed wire is often used to confine hogs while they are hogging down corn (fig. 9). Woven-wire hog fences with 9- or 11-gage stay wires are more satisfactory and longer lasting than fences with lighter stay wire.

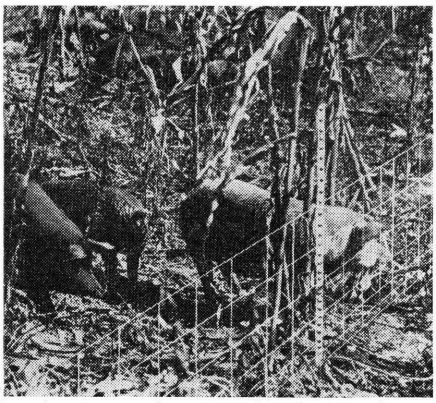


FIGURE 9.—A fence of woven wire on shallow-driven steel posts can be quickly disassembled and moved.

A woven-wire fence 32 inches high will confine hogs and permit the caretaker to cross without putting enough weight on the fence to damage it. A 39-inch fence may be damaged by persons climbing over it. A woven-wire fence only

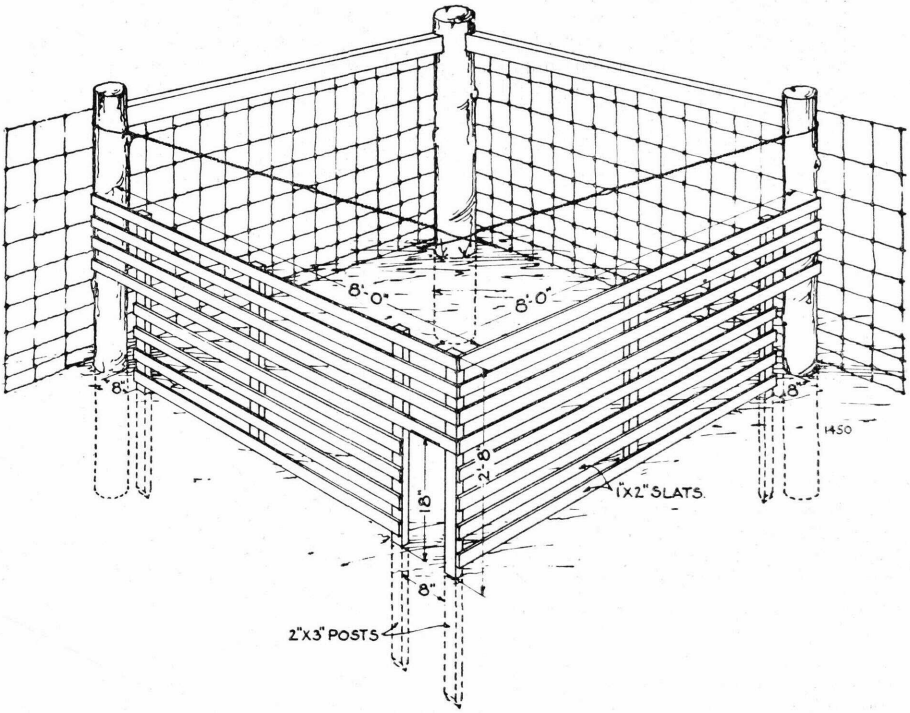


FIGURE 10.—A design for the construction of a creep for small pigs.

26 inches high is preferable when used as a temporary hog fence in a cornfield, since it may be easily rolled between corn rows. A hog-tight fence with barbed wire alone requires six strings of wire, and often costs more to build and maintain than a woven-wire fence. Barbed wire with 4-pointed barbs spaced 5 inches apart is designed principally for hogs.

Creep-feeding pens used for small pigs should have two or more openings which permit pigs to enter but keep the older hogs out (fig. 10). For cattle, a fence 48 inches high is generally desired. Barbed-wire cattle fences between neighbors' property should have 5 lines of barbed wire spaced 9 inches apart with the bottom wire 12 inches aboveground. Fences which divide

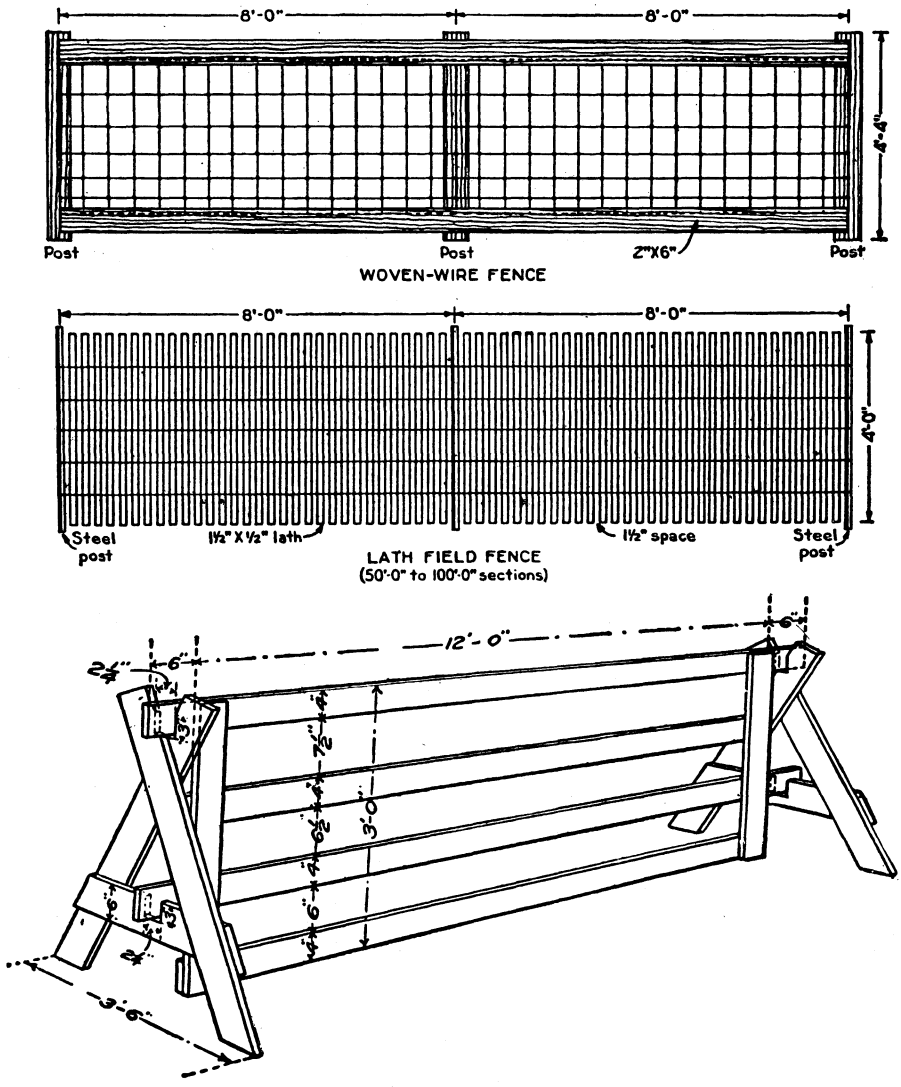


FIGURE 11.—Three economical types of sheep fences: Upper, combination wire and boards; middle, a movable slat or snow fence; lower, a portable fence useful for pasture and soiling crops and temporary lots.

pastures on the same farm should have 3 lines spaced 24, 36, and 48 inches aboveground. Small calves, however, may crawl under such a fence. In the Western States large permanent cattle pastures are fenced with three strands of barbed wire, and in some sections of low-priced land two strands are used. Such fences do not restrain all animals, and "fence-busters" should be provided with yokes or other devices to keep them inside the fences.

Sheep must be carefully herded if they are not in a fenced pasture, and herding often involves considerable expense. In many cases it is possible to use temporary sheep fences (fig. 11).

Sometimes it is worth while to build fences that will protect sheep against coyotes and dogs. A comparatively simple fence will restrict sheep, but to protect them from predatory animals requires more expensive construction. An extended arm (fig. 12) discourages dogs from jumping over the fence. In some of the sheep-raising sections of Texas an apron of woven wire 18 inches wide is laid on the ground and fastened to the woven wire. The apron is staked down or weighted down with rocks to prevent predators from burrowing beneath the fence line. Woven-wire fences are particularly valuable for sheep lots or pastures; barbed wire tears the fleece. Woven wire of standard specification is often used for sheep fences, but in semiarid and high-plateau regions lighter wire is commonly used.

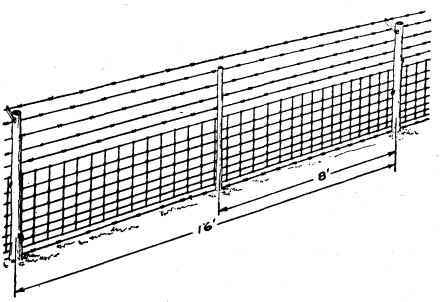


FIGURE 12.—A dog- and coyote-proof fence used in range-sheep production.

Protection of young orchards, nurseries, or truck gardens from rabbits and other rodents is often necessary. Large areas may be effectively protected by using 1½-inch mesh or finer mesh netting about 3 feet high. Where only a small number of scattered trees are to be protected, shields or netting placed around the trunk give considerable protection. One-inch mesh poultry netting or wire cloth 18 inches wide is used for protection against cottontails. Higher shields are needed to prevent damage by jackrabbits. In regions of heavy snow the height of the shield needed for rabbit protection varies depending on the depth of the snow. Veneer boards, heavy building paper, gunny sacks, or cloth wrappings give temporary protection.

Figure 13 illustrates how a farmer may design and construct fences to fit special needs on his farm.

Electric Fences

An electric fence (fig. 14) is a barrier of one or more wires carrying sufficient voltage to cause a disagreeable shock to persons and animals that touch it. Electricity, even at extremely low voltage, is dangerous if improperly used. Injuries to persons and livestock have caused some States to set up regulations regarding the design and use of electric fences. Since the effect of electric shock varies with the age and physical condition of individuals, it is important that regulations provide for safe fencing for all. The following safeguards have been generally accepted:

1. Maximum current output must be limited. It is the quantity, or amperage, of current passing through the body that is responsible for injuries from electric shock. A properly designed controlling device will control the amperage with whatever voltage is used. On the other

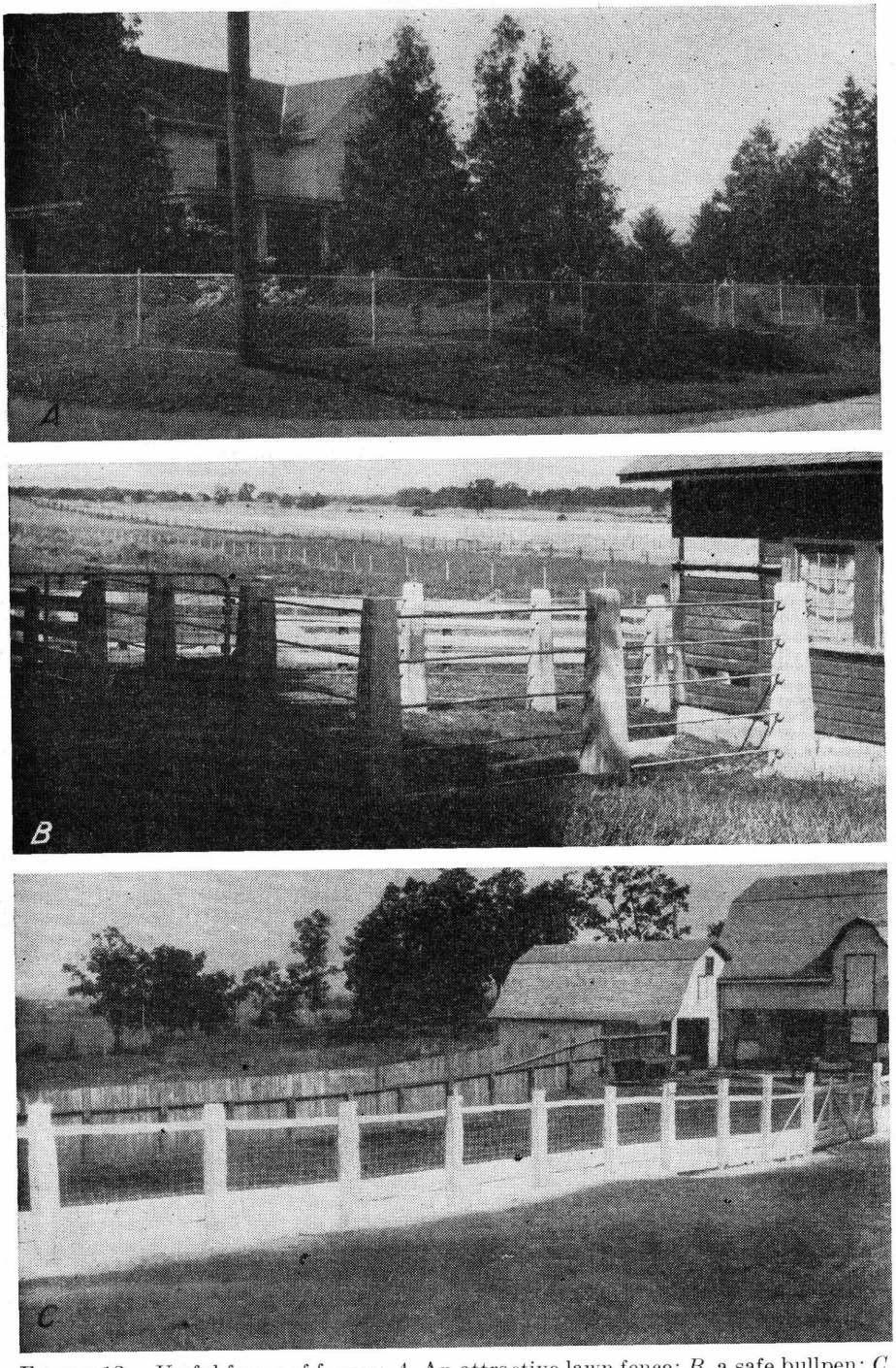


FIGURE 13.—Useful forms of fences: *A*, An attractive lawn fence; *B*, a safe bullpen; *C*, a windbreak (background) on the feed lot.

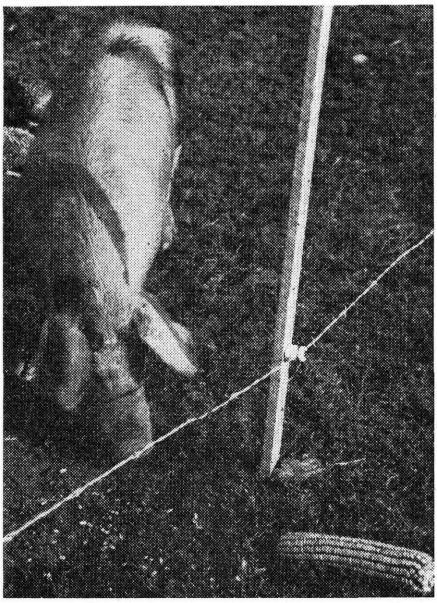


FIGURE 14.—Electric fences are low in cost because strong, durable posts are not required and only one wire is needed if the fence is for one type of livestock.

FIGURE 15.—An electric fence is not safe unless the current is regulated by a well-designed and properly installed controlling mechanism.

hand, if the amperage is not properly limited by the controlling device, even low voltages may cause dangerous shock if the subject is standing on wet ground or in contact with a grounded object. The amount of current required to cause people to "freeze" to the conductor varies with individuals, but it seems that "freezing" can be prevented by limiting current to one one-hundredth of an ampere—10 milliamperes.

2. Interrupted current with duration of charge not to exceed one-tenth of a second. The intervals between charges should be long enough to give an individual in contact with the fence time to free himself.

3. Controlling mechanism designed so that the circuit-breaking device cannot stop in closed position.

4. Current controller sealed in a tamperproof box (fig. 15).

5. Housing and nonconducting parts of controller effectively grounded.

6. Only those models of fence controllers which have been approved by Underwriters' Laboratories, Industrial Commission of Wisconsin, or other such generally recognized institutions should be used.

7. Full instructions for installation and use furnished by the manufacturer of electric fences with each controller. These instructions should be followed faithfully.

8. The fence must be equipped with lightning arresters to prevent loss of property and livestock.

The principal uses of electric fences are:

1. For supplementary fencing, for temporarily enclosing pastures, feed lots, or haystacks, or for dividing off fields of corn or other crops to be hogged down.

2. For placing inside bullpens to keep bulls from damaging the heavy fences which should always be used.

3. To discourage prowlers and predatory animals.

4. For fencing marginal land which does not warrant an investment in permanent fencing, for fencing in areas where good fence posts are scarce, and for rocky land where it is hard to dig fence-post holes.

5. As a protective measure against depredation of wildlife, electric fences have been used with variable success. Four charged wires have kept bears out of apiaries and two wires may keep deer and antelope away from haystacks.

Advantages claimed for electric fences are:

1. Low cost. The relative cost of an electric fence and a conventional barbed-wire fence will vary with the length of the fence. In long fences the cost of extra

wires and posts for conventional fencing may more than equal the cost of the controller, connections, and insulators for electric fencing. The amount of electrical energy consumed by electric fences is practically negligible, but the upkeep includes the cost of keeping vegetation cut along the fence.

2. One wire required. This claim may be correct where stock of one kind and one size is to be restrained but not if the stock is of different kinds and sizes.

3. Easily moved.

The principal disadvantages of electric fences are:

1. A painful shock results from contacting the live fence wire.

2. Livestock require initial training to respect charged wires.

3. The current may fail and allow the stock to get out.

4. An electric fence cannot be depended upon to stop infuriated bulls or stampeded animals.

5. Weeds, grass, or shrubbery may ground the fence wire and it may be necessary to cut weeds and grass several times a season.

6. Some types of electric fences need adjustment to weather conditions. Fences in dry soils require higher voltage than fences in wet soils. With some designs, the higher voltage used in fences in normally dry soils is dangerous in wet weather.

7. Some units may interfere with radio and television reception.

It is dangerous to use electric-fence controllers constructed by untrained and unskilled workmen. A person will probably have difficulty in making controllers that will come up to the generally accepted standards unless he is thoroughly familiar with their requirements and characteristics and has the necessary equipment.

State electrical inspection services in States where inspection is compulsory are not likely to approve the use of homemade controllers unless they are first submitted to some recognized laboratory for test. Before buying or installing an electric-fence controller a farmer should investigate local and State regulations to ascertain whether their use is permitted and what the regulations are concerning their installation and use.

Many engineers believe that no matter how carefully controllers are designed and built, they are subject to mechanical breakdown or to insulation failure. These engineers believe that, since controllers are not perfect protection, the same precautionary measures should apply to the use of electric fences as apply to any other uninsulated or unprotected electric conductor. Therefore, the user of an electric fence should become familiar with precautionary measures.

A severe electric shock, regardless of the source of electricity, is likely to paralyze the muscles that control breathing or to interfere with the regular rhythmic beating of the heart. To revive a person from electric shock use the same methods of restoring respiration that are used in cases of asphyxiation from gas or drowning and call a doctor at once.

Fence Posts

The three classes of materials commonly used for fence posts are wood, metal, and concrete. Where timber is plentiful wood posts are used more than other kinds of posts. The initial cost is important in selecting posts, and other factors which should not be overlooked are durability and ease of maintenance. Care should be taken to select a post which is sturdy enough to do the job for which the fence is built.

Wood Posts

Osage-orange, black locust, cedars, white oak, and catalpa are among the more durable untreated wood posts but they are not available in all parts of the country. However, most areas have other species which are suitable for fence posts provided treatment is given with a good wood preservative. In many areas the farm woods can

be an important source of fence posts. Waste or otherwise untillable land may be used for woodland from which suitable trees can be selected for posts and lower grade trees can be used for firewood. State forestry departments can recommend the best species to grow in a given area.

Posts low in first cost are often not the cheapest when length of service is considered. Farmers should select the most durable posts available or treat the less durable wood. Posts should probably last as long as the fencing attached to it, or the maintenance cost will be high.

The life span of untreated posts, even of decay-resistant species, depends largely upon the proportion of heartwood present. In general, the outer heartwood is the most decay-resistant part. No species has decay-resistant sapwood. It is desirable to select posts with little sapwood if they are to be used without preservative treatment. Posts with a large proportion of sapwood should be treated regardless of species.

Untreated wood of different species may be divided into three classes of durability as listed below. Information for the list was supplied by the United States Forest Products Laboratory.[2]

Class 1.—Woods of high durability that will probably remain in service longer than 15 years.
Hardwoods:
- Black locust
- Osage-orange

Class 2.—Woods of intermediate durability that will probably last from 7 to 15 years.
Hardwoods:
- Catalpa
- Oak (white)
- Red mulberry
- Sassafras
- Walnut (black)

Softwoods:
- Baldcypress
- Cedar (various species)
- Redcedar (eastern or western)
- Redwood

Class 3.—Woods of low durability that will probably last from 3 to 7 years.
Hardwoods:
- Ash (various species)
- Aspen (popple)
- Basswood
- Beech
- Birch (various species)
- Boxelder
- Butternut
- Cottonwood
- Elm (various species)
- Hackberry
- Hickory (various species)
- Honeylocust
- Maple (various species)
- Oak (red)
- Sweetgum
- Sycamore
- Willow (various species)

Softwoods:
- Balsam fir
- Douglas-fir
- Hemlock (eastern)
- Larch (western)
- Pine (various species)
- Spruce (various species)
- Tamarack

In stiff soil, posts usually decay first just below the top of the ground. Posts that are in continually damp soil rot very slowly. Rotting is most rapid at the ground line in soils with a widely varying moisture content. In porous or sandy soil posts usually rot from the top of the post down. Rotting at the top of the post is due to rain being absorbed. The value of seasoning posts is questionable unless the posts are to be treated with a preservative. Peeling is recommended, since the bark harbors insects and traps moisture which hastens decay. The season of the year when wood is cut is not known to have any effect on its decay resistance.

Tops of posts are often given a slope of not less than one-fourth pitch with the high side next to the

[2] Estimates are for average durability of round posts with a 5- to 6-inch diameter. Larger posts or split posts cut from large trees and having a low proportion of sapwood will probably last longer. In the tabulation, "hardwoods" refers to the botanical group of trees having broad leaves, and "softwoods" to the group having needlelike or scalelike leaves. Neither term has any reference to the actual hardness of the wood.

wire. Some posts have double pitch, while the top of a round post may be tapered. There is no evidence, however, to show that sloping or tapering the top of a post adds to its life.

Preservative Treatment

The advisability of treating wood fence posts depends upon the available supply and the cost of posts of durable woods as compared with the supply and cost of posts of less durable woods that must be treated. In many localities pressure-treated creosoted posts are available. Such posts are highly resistant to rot and to termite and other insect damage and are superior to most home-treated posts. Their cost is largely determined by freight rates and distance shipped. In choosing between pressure-treated and home-treated posts consideration should be given to cost and quality, and to availability of home facilities, materials, and labor.

Preservative treatment makes possible the economical use of home-grown wood otherwise unsuitable for posts. Preservatives purchased in small quantities may cost several times as much per gallon as preservatives purchased in sizable lots. Equipment for treating fence posts can often be purchased jointly by two or more farmers. Information on the different preservative treatments can be obtained from State agricultural colleges or from Farmers' Bulletin 2049, The Preservative Treatment of Fence Posts and Farm Timbers. To obtain this bulletin write to the Office of Information, United States Department of Agriculture, Washington 25, D. C.

Different preservatives for home treatment are available. The principal ones are coal-tar creosote, petroleum oils containing either pentachlorophenol or copper naphthenate, and zinc chloride. Several good proprietary preservatives are also available for on-the-job application but the user should obtain authoritative information on their composition, performance, and recommended application procedures before using them. Mercuric chloride, sodium fluoride, and other kinds of salts have been tried but are not used extensively. A preservative should be safe to use, reasonably cheap, noncorrosive to metals, and poisonous to fungi and insects. It should penetrate the wood readily and not wash out easily.

In the South or in other areas where conditions are favorable to decay, the entire posts should be treated. In semiarid regions only the butts need be treated. In butt treatments the posts should be treated to a height of not less than 6 inches above the ground line. This height should be greater if it appears likely that the ground line will be raised through plowing, road grading, or the piling of manure around the posts.

Paints as a general rule do not prevent decay and sometimes may hasten decay. Painting the posts, however, improves the appearance of a fence and makes it easier to see (fig. 16). Dipping posts in cement paint or paste is mostly wasted effort.

Setting posts in concrete is usually a bad practice since the post

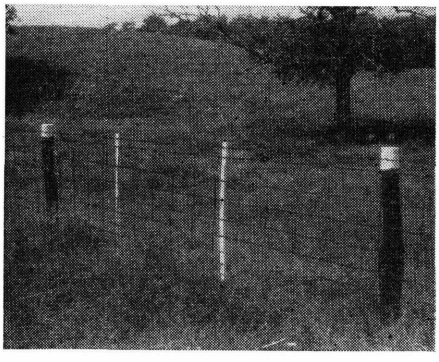


FIGURE 16.—A fence is made more visible by painting the tops of posts with aluminum paint and placing stays between the posts.

shrinks from the concrete and leaves a crack for moisture to enter. There is little opportunity for the trapped moisture to evaporate and the post may quickly rot at the junction line of the two materials. With durable woods or treated posts the stability and convenience of concrete for anchorage often justifies its use. The concrete collar should extend well above the ground, and the top edge should be sloped so as to give good drainage.

Size of Posts

The size of wood posts may vary considerably with the strength and durability of the species used. Line posts of Osage-orange are sometimes as small as 2½ inches in diameter. With other woods, line posts are commonly 4, 5, or 6 inches in diameter, and corner posts and gateposts 6 to 8 inches in diameter. The least dimension for split posts is usually not less than 5 inches. Large posts usually last longer than smaller posts of the same wood.

Wood posts usually are set 2½ feet in the ground. The overall length depends on the height of the fence, but is generally 7, 7½, or 8 feet for line posts. Gateposts and brace posts are of sufficient length to meet the services required.

Metal Posts

Metal posts are made of steel, alloyed steel, and wrought iron. Copper-bearing steel or other rust-resistant steel alloys are desirable if the added alloy prevents corrosion. Metal posts may be obtained either painted or galvanized. Durability tests started in 1925 by the South Dakota Agricultural Experiment Station indicate that steel posts dip-painted with lead and oil

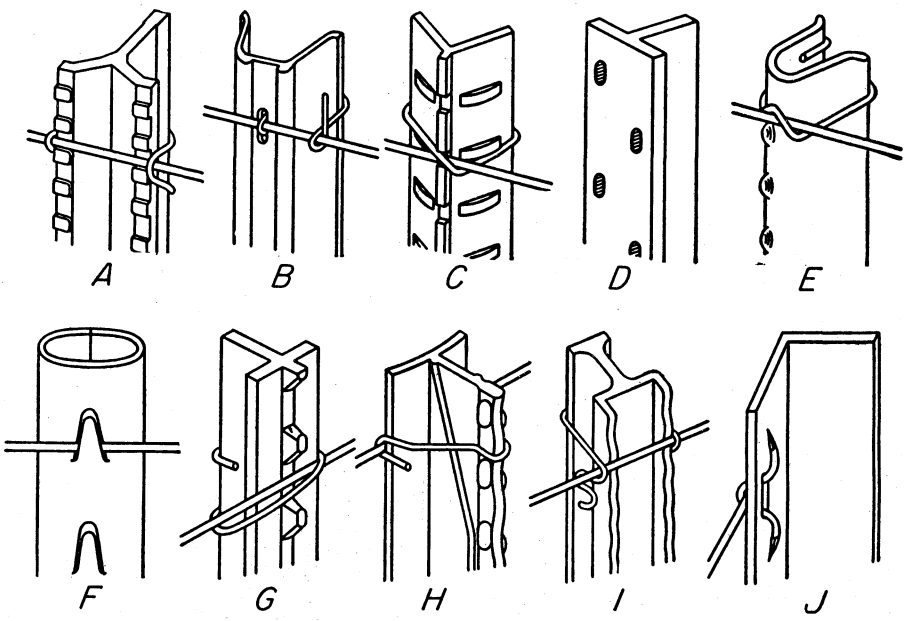


FIGURE 17.—Steel farm fence posts, showing typical shapes, wire binders, and surface treatment. Shapes or forms: Angles, *C* and *J*; Y-form, *A*; tees, *D*, *G*, *H*, and *I*; channel or U-bar, *B* and *E*; circular, *F*. Binders: Twisted wire, *C*; staples, *D* and *J*; slip on *G* and *I*; clip and twist, *A*, *B*, *E*, and *H*; lipped, *F*. Surfaces: Studded, *C* and *G*; embossed, *A*, *C*, and *E*; channelled, *A*, *B*, and *I*; perforated or punched, *B*, *D*, and *J*.

paint rust within 5 to 7 years. Steel posts in the test which were brush-painted with metallic zinc, however, gave as good service as galvanized posts and had a good appearance after 25 years.

The cost of metal posts is a disadvantage, but there are certain advantages which tend to offset this. Metal posts protect stock against lightning by grounding the current, and they are light in weight and easily handled. Metal posts may be easily driven into most soils, which reduces the labor and cost of setting.

Metal posts are made in several shapes (fig. 17). These various shapes may be punched, perforated, lipped, studded, or otherwise deformed. A number of devices are used for fastening wire to metal posts. Decreasing the area of contact of post and line wire to provide drainage and reduce rust is accomplished by the deformations. The weights of the common forms of metal posts are given in table 5.

Objections to steel posts are the lack of resistance to the crowding of stock and the ease with which lightweight posts are bent. Anchor plates may be bolted, clamped, or riveted to the base of steel posts to prevent stock from forcing them out of line. The three most common forms of anchor plates are flat plate, bent plate, and split wing (fig. 18).

In some areas close to oilfields, boiler factories, or repair shops, used pipe may be obtained at reasonable prices for fence posts. These should be at least 1¾ inches in diameter for line posts and larger for corner posts. Heavy corner posts or gateposts can be made of pipes 6 or 8 inches in diameter filled with concrete.

Metal posts may be easily and quickly driven in heavy clay soils with an ordinary 12- to 16-pound steel sledge or post maul, in which case a driving cap over the post is used. In lighter soil a 16-pound sleeve driver that can be operated by one man may be used. This

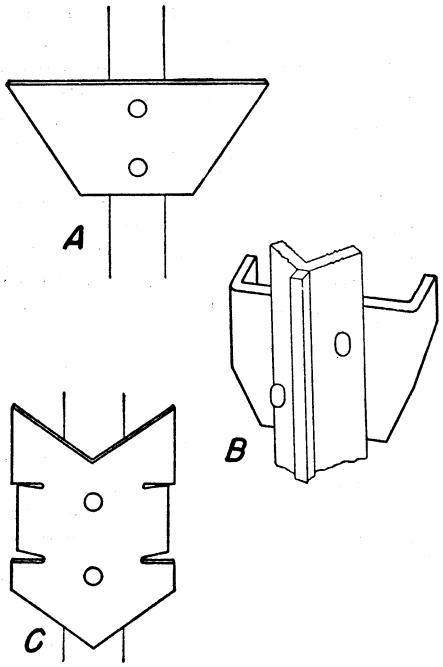


FIGURE 18.—Common forms of steel-post anchors: *A*, Flat plate; *B*, flat plate bent; and *C*, split wing.

method of setting posts, where feasible, saves considerable labor over that of digging holes and tamping posts.

Concrete Posts

Concrete posts (fig. 19) give satisfactory service if made of good concrete and properly reinforced. Success in making concrete posts depends on proper mixing of the concrete, the use of suitable aggregate, the proper placing of the right kind and amount of reinforcing, care in handling green posts, proper curing or seasoning before use, and careful handling to avoid breaking or cracking. Unless these principles are observed, failure is likely to result. Concrete gateposts and corner posts are made in various sizes and shapes to fit various conditions. Concrete posts are usually cast in place and should be thoroughly cured before the fence is attached. It is essential that they

TABLE 5.—*Approximate weight and sizes of common metal posts for farm fencing*

Shape	Nominal size	Weight for posts of length indicated									
		5 feet	5½ feet	6 feet	6½ feet	7 feet	7½ feet	8 feet	9 feet	10 feet	11 feet
		Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Round	No. 8 gage, 2½ inches	[1]	[1]	27. 1	[1]	29. 1	31. 0	32. 9	36. 6	40. 4	44. 1
Do	No. 14½ gage, 1¾ inches	7. 0	[1]	8. 4	9. 1	9. 8	10. 5	11. 2	[2] 15. 2	[2] 16. 7	[2] 18. 3
Angle L	1¼ by 1¼ by 9/64 inches	6. 20	6. 76	7. 32	7. 88	8. 44	9. 00	9. 56			
Light T	1⅜ by 1⅜ by 9/64 by ⅛ inches	6. 92	7. 55	8. 17	8. 80	9. 42	10. 05	10. 67			
Heavy T and Y	1½ by 1½ by ⅛ by ⅛ inches	7. 32	7. 99	8. 65	9. 32	9. 98	10. 65	11. 31			
Channel	1 15/16 by 1 3/16 by 25/32 by 7/64 inches	6. 20	6. 76	7. 32	7. 88	8. 44	9. 00	9. 56			

[1] Not commonly made in this length.
[2] For corners and braces, 13½ gage.

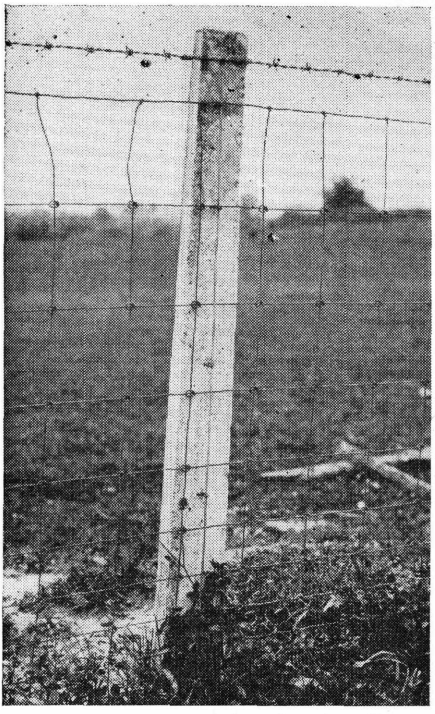


FIGURE 19.—Concrete posts can be made with farm labor and equipment.

be made of good concrete and properly reinforced.

For more information on making concrete posts see Farmers' Bulletin 1772, Use of Concrete on the Farm. To obtain this bulletin write to the Office of Information, United States Department of Agriculture, Washington 25, D. C.

Posts for Stony Land

In shallow or rocky soil it is often impractical to set posts in the ground and special types of posts are required. Figures 20 and 21 show two aboveground types of posts. Rail fences are another solution to the problem of fencing on rocky land.

Wire and Post Fasteners

Nails, staples, twisted wire, and various forms of clips are used to fasten boards and wire fencing to

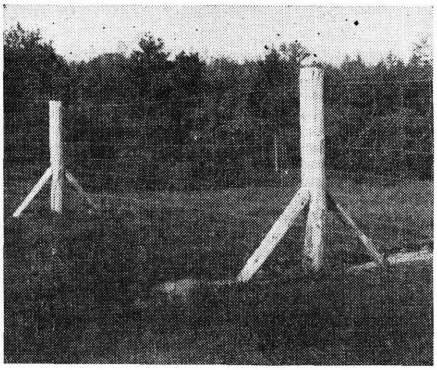


FIGURE 20.—In shallow soil above rock, posts may be set on sills and braced.

posts. All fasteners should be galvanized.

No. 9 wire is ordinarily used for fence staples. The length and style of staples used for wood posts should vary with the hardness of the wood: ¾- and 1-inch staples are satisfactory for Osage-orange, but 1¼- and 1½-inch staples should be used for the softer woods. Less splitting of the wood will occur if the staples are driven in diagonally to the grain. They should be set so as to hold the wire securely but should not be buried in the post, as this often nicks or bends the wire and results in rapid corrosion. The fence should be fastened to the post in such a

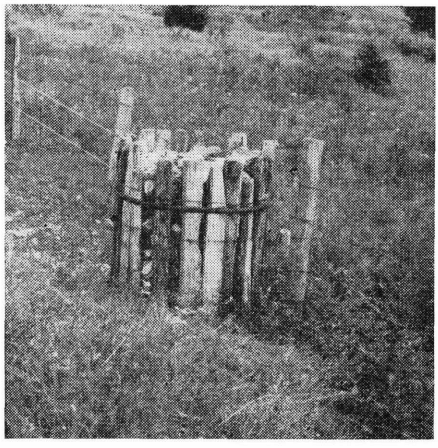


FIGURE 21.—Rock-filled corner post or gatepost for stony land.

TABLE 6.—*Weight of commonly used staples required for various spacing of posts*

Post spacing in feet	Posts per 80 rods	Weight of staples required for 80 rods of fence			
		1 inch	1⅛ inches	1¼ inches	1½ inches
	Number	*Pounds*	*Pounds*	*Pounds*	*Pounds*
8	165	11. 5	12. 5	15. 0	16. 8
10	132	9. 2	10. 0	11. 1	13. 4
12	110	7. 6	8. 3	9. 2	11. 2
16½	80	5. 6	6. 1	6. 7	8. 1

way as to allow for the contraction, expansion, and distribution of strain caused by the crowding of stock.

Table 6 gives information helpful in estimating the number of No. 9-gage staples needed to staple 80 rods of woven-wire fence to wood posts. Table 7 gives the length and gage of commonly used staples, and the number of staples per pound. The figures in table 6 have been calculated by allowing seven staples per post, and adding 5 percent for loss and waste. This is about the average number used. In estimating the number of staples required for a 2-, 3-, or 4-line barbed-wire fence, corresponding reductions should be made.

TABLE 7.—*Length, gage number, and number per pound of staples commonly used for fencing*

Type of service	Length	Wire gage	Staples per pound
	Inches	*No.*	*Number*
Fence wire	1	9	106
	1⅛	9	97
	1¼	9	87
	1½	9	72
Poultry netting	¾	14	499

The use of metal and concrete posts has caused the development of many new fasteners or clips. Figure 17 shows several of the common forms now in use. Each manufacturer furnishes special clips particularly suited for his post. A fastener should provide good drainage of water, be easy to fasten or remove, and retain a minimum of dirt. Dirt hastens corrosion. Wire is fastened to the lipped form of fastener (fig. 17, *F*) by tapping the lip with a hammer. Such forms must be ductile to permit the fastening or removal of wire several times without danger of breaking. The most common method of fastening fencing to a concrete post is to wrap short pieces of wire around the fence and post.

Spacing Posts

The life of the fence and the maintenance cost are closely associated with the size and spacing of the fence posts. Some of the best fences have a post spacing of about 12 feet and many miles of field fences are built with posts spaced 1 rod apart. In large pastures in the West where several acres are used to graze each animal, spacings up to 50 feet are sometimes used and the wire between the posts is supported by wood stays or small posts. Where post timber is scarce this is a common practice. The size of stays or small intermediate posts varies considerably. Stays 1½ to 2½ inches in diameter are used for sheep fences (fig. 22). Wire stays

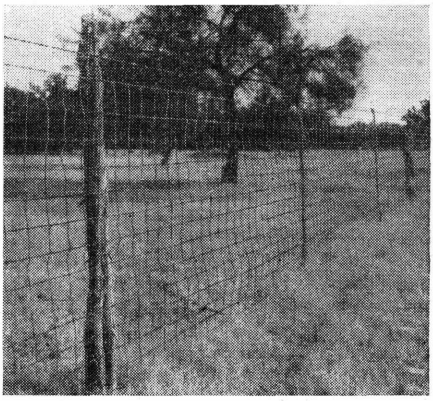


FIGURE 22.—A sheep fence with wide spacing of the line posts and wooden stays between the posts to support the wire.

sometimes are twisted into the line wires to give greater stiffness to the fence and to reduce the spread between wires, but this practice may hasten the corrosion of the line wires. In dry areas the practice is less objectionable than in humid areas.

If heavy livestock are to be confined in small lots or pastures the posts are often set 8 feet apart, which greatly increases the service life of the fence. Closer spacing of posts is required for hogs than for sheep, although the same height of fence may be used for both.

Figure 23 shows that the shape of the field affects the length of fencing required per unit area and emphasizes the importance of this factor in laying out fields. Ten acres in the form of a square requires 160 rods of fencing, whereas if the width is but one-fourth the length, 200 rods are required to fence 10 acres. As the size of the field increases the fencing required per acre decreases. Table 8 gives the number of line posts required per 100 rods of fencing for different post spacings.

TABLE 8.—*Number of line posts required at various spacings for 100 rods of fencing* [1]

Post spacing (feet)	Number of posts	Post spacing (feet)	Number of posts
8	205	20	83
10	165	25	66
12	138	30	55
14	118	40	42
16½	100	50	33

[1] Corner and gate posts are additional.

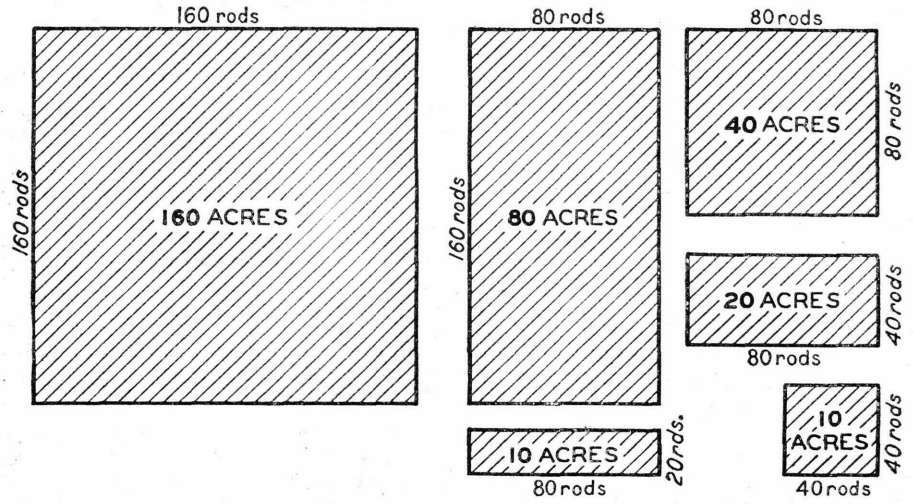


FIGURE 23.—The length of fencing required per acre varies with the size and shape of the fenced area.

Life of Fences

Climatic conditions, usage, wood species and treatment used for wood posts, protective coatings for steel posts, and the gage and amount of galvanizing for fence wires all affect the service life of a fence. The expected life of fence posts is discussed on pages 15 and 16.

Table 9 was prepared from a report on atmospheric corrosion tests on wires which is being conducted by the American Society for Testing Materials. Tests are being made at 11 different locations in the United States. Livestock did not come in contact with the test fences. The report covers only about 14 years of testing; values given in table 9 for strength loss over periods of years longer than the test period are estimates. Indications are that the values given in table 9 for 9- and 11-gage wire are conservative. The values given are based on wires coated with 0.38 ounce of zinc per foot of surface. A coating of zinc weighing 0.58 ounce would increase the life of the wires about 3 years.

The test specimens at Sandy Hook were about 300 yards from the Atlantic Ocean and they showed the effect of salty atmosphere on wire fencing. Exposure conditions at Ames were similar to those at the South Dakota Agricultural Experiment Station, where steel posts were tested for corrosion. A wire fence should still be usable under ordinary service conditions after losing 25 percent of its original strength.

TABLE 9.—*Length of time required to cause 25- and 50-percent loss of strength of wire in galvanized fencing under differing atmospheric conditions*

Loss of strength and location	Time required to cause strength loss			
	14½ gage	12½ gage	11 gage	9 gage
25-percent loss:	*Years*	*Years*	*Years*	*Years*
Sandy Hook, N. J.	6	8	10	12
Lafayette, Ind.	13	18	19	19
Ames, Iowa	19	23	36	36
50-percent loss:				
Sandy Hook, N. J.	9	12	16	21
Lafayette, Ind.	19	32	32	32
Ames, Iowa	28	36	61	61

Cost of Fencing

The initial cost of heavy-gage wire is more than that of the smaller sizes, but the cost of construction is practically the same for heavy and light wires and the maintenance cost for heavy wire is less. Heavy-gage wire is economical in the long run because of its longer life.

The number of rods of fence that may be erected in a day will vary with soil condition, topography, efficiency of labor, and type of fence erected. No single table of cost data can be prepared which will enable a farmer to make a close estimate of the cost of any fence for any locality. However, tables 6, 7, and 8 are helpful in estimating the material requirements. Each farmer can estimate the length of

wire required for his fencing, and an overall estimate of material cost can be made by getting price quotations from local dealers.

The following figures show the average labor requirements for various fencing operations on fairly level ground: [3]

1. Time required for two men:
   - A. To set 1 wood end post complete with brace post and brace 4 feet in ground — 3 hours
   - B. To set 1 wood corner post complete with brace posts and braces — 4 hours
   - C. To set 1 steel end post and brace in concrete 4 feet in ground (exclusive of concrete work) — 2 hours
   - D. To set 1 steel corner post and braces in concrete (exclusive of concrete work) — 2½ hours
2. Amount of work 2 men can accomplish in 10-hour day:
   - A. Number of wood line posts set 3 feet deep — 50 to 60
   - B. Number of steel line posts driven 2½ feet deep — 300 to 500
   - C. Number of rods of 47-inch woven-wire fence (type 1047) with 1 barbed wire, stretched and attached to:
     - Wood posts — 90 to 100
     - Steel posts — 80 to 90
   - D. Number of rods of 26-inch woven-wire fence (type 726) with 4 barbed wires, stretched and attached to:
     - Wood posts — 75 to 80
     - Steel posts — 60 to 75
   - E. Number of rods of 5-line, barbed-wire fence stretched and attached to:
     - Wood posts — 60
     - Steel posts — 50 to 60
   - F. Number of rods of old fence with wood posts torn down — 100

Construction Methods

Good workmanship is an important factor in determining the life and service of a farm fence. A carelessly or loosely built fence will be costly to maintain and will cause frequent annoyance.

After the fence line has been located the ground should be cleared of all obstructions such as stones, stumps, brush, and trash. When the corners are located, a line of sighting poles may be erected at important points or a line stretched. The locations of the postholes are then established along this line and marked with pegs where exact spacing is necessary. The spacing and depth of postholes are governed by the factors previously discussed (p. 22). An auger (fig. 24, *B*) or a posthole digger (fig. 25) is commonly used on small farms to make postholes in a loose soil or the black loams of the Corn Belt, while in heavy clays a spade or digger is used. In stony land it is sometimes necessary to blast.

Steel posts are commonly driven to the desired depth with a sliding sleeve of approximately 16 pounds weight. Occasionally wood posts are sharpened and driven. A wood block may be used in driving wood posts to protect the tops of the posts. The work of driving posts with a maul or sledge can be done more easily if the worker stands 2 or 3 feet above the ground. A wagon or truck used for hauling the posts may be used as a stand.

An auger attachment for tractors (fig. 26) is generally available on large farms and can drill about 20 times as many holes per hour as one man can do manually. Auger attachments can be used to drill postholes in nearly every type of soil except solid rock. With proper attachments the auger may be

[3] Information from Farm Fence Handbook by Henry Giese, Iowa State College, Ames, Iowa.

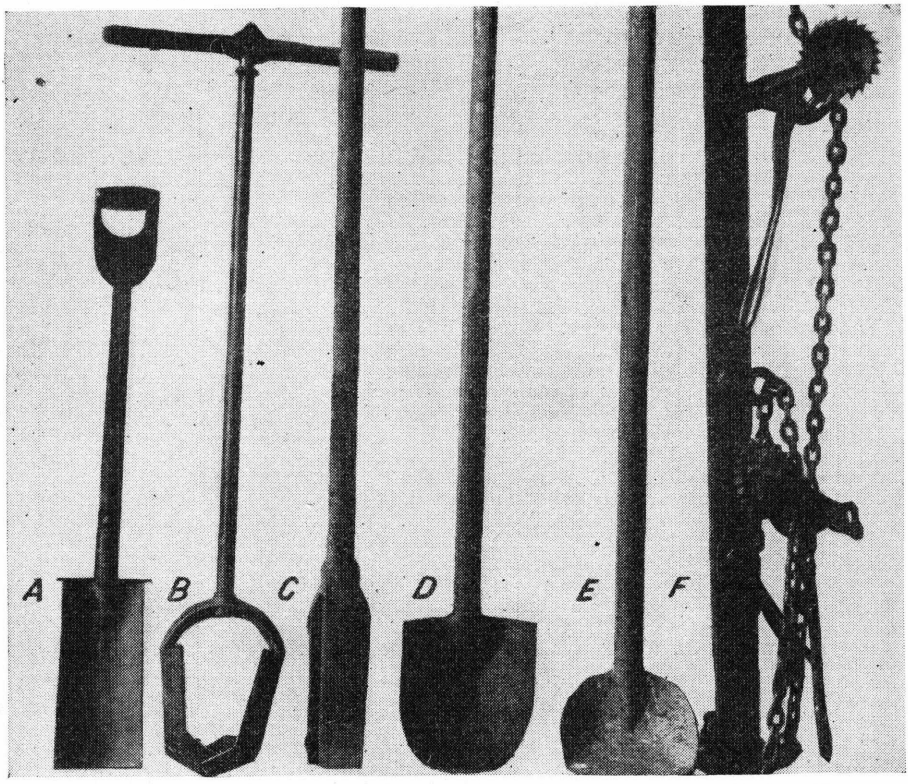


FIGURE 24.—Hand tools used in the construction of farm fences: *A*, Spade; *B*, auger; *C*, tamper; *D*, round-pointed shovel; *E*, spoon shovel for removing dirt; *F*, two-jack fence stretcher.

set at various angles, as required by the slope of the ground. If long lines of fence are to be erected the use of motor-powered drivers or augers may be justified.

The appearance of fences is often marred by posts that are set out of line or at different heights and spacings. When steel posts are used the fence may be stretched before the line posts are driven. The fence will help in alining the posts and in obtaining even spacing. The tops of wood posts may be cut off evenly after they have been alined and set. On fairly level ground the post may be set at a regular height by a gage mark on the tamping bar.

A good tamping bar may be made of steel or wood faced with steel (fig. 24, *C*). A steel bar 1 inch in diameter or an old piece of shafting pointed on one end and with a flat head welded or upset on the other end is very useful. The pointed end may be used in starting holes for driving posts and for removing rock or other obstructions from holes. Posts must be firmly set in order to maintain an erect position. A small amount of soil should be backfilled at a time and well tamped before more is added.

Good wirecutters or pliers are essential for building fence. Combination tools which can be used as a plier, staple puller, wirecutter, splicer, and emergency hammer are obtainable and are very useful.

Bracing Posts

End and corner posts are the foundation for a fence. Failure of these posts, which is all too com-

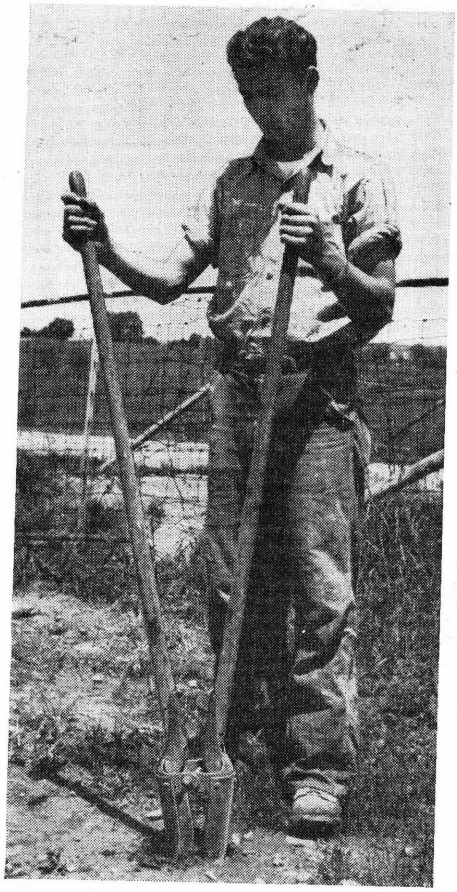


FIGURE 25.—This type of posthole digger is commonly used for fencing jobs that require few holes.

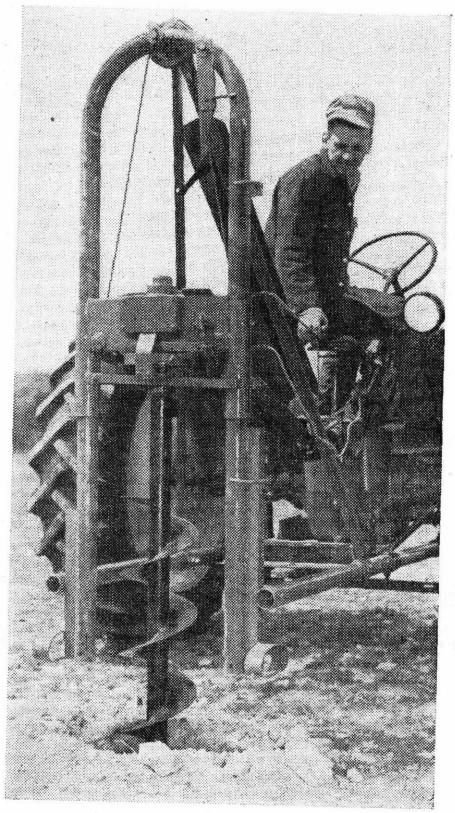


FIGURE 26.—A posthole-digger attachment for farm tractors.

mon, necessitates complete rebuilding of the fence. Failure of line posts, however, causes only local trouble which can be repaired easily. Special care should therefore be taken in the design and construction of end- and corner-post assemblies. The principal types of bracing assemblies for end and corner posts are shown in figure 27.

Corner posts tend to lift out of the ground at even a moderate pull from the fencing, unless the tie wire is fastened to a "deadman" as shown in figures 27, *G*, and 28. Sometimes the corner posts are driven about 4 feet into holes bored to the exact size of the post. This method increases the holding power and resistance to uplift considerably.

Double-span assemblies for end and corner posts have more than twice the strength of the single spans and only half the horizontal or vertical movement under heavy loads. Laboratory and field tests on the types of bracing illustrated in figure 27 conducted at Iowa State College show that type *A* will buckle sideways under extremely heavy loads and that type *B* is superior. Indications are, however, that type *C* is the best of the three. It is preferable to have at least some of the fence load applied to the center post. This may be accomplished by stretching the woven wire to the corner post and the barbed wire to the center post when a combination fencing is used.

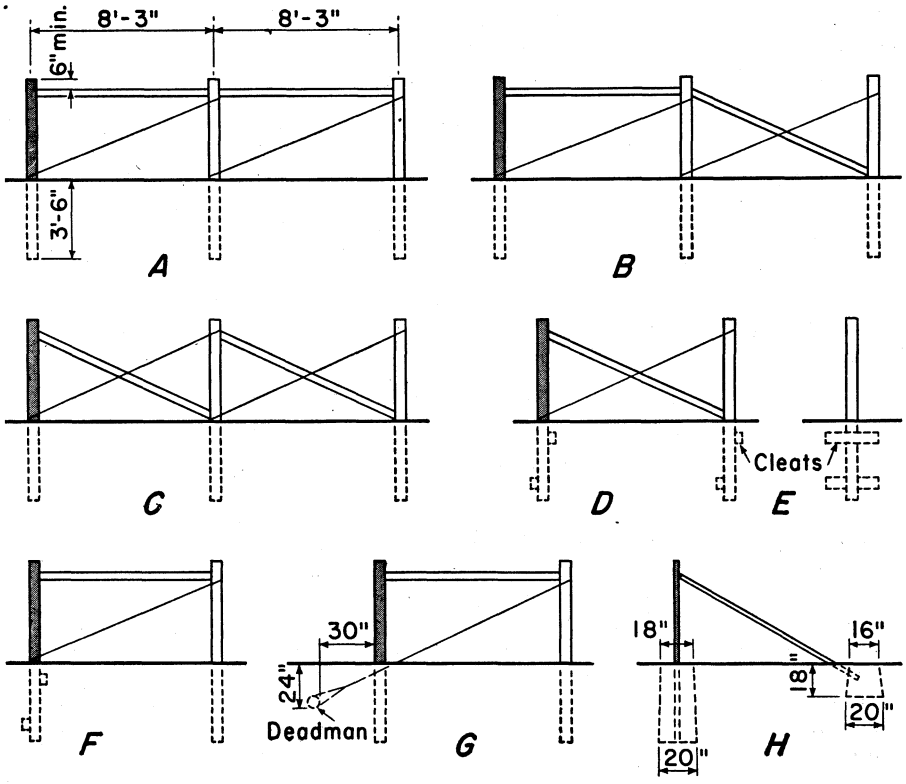


FIGURE 27.—Bracing assemblies for end and corner posts: *A*, *B*, and *C*, Double-span assemblies with struts and ties; *D* and *F*, single spans with strut, tie, and cleats (*F* requires cleats on corner post only); *E*, cleats used to resist both horizontal and vertical movement of individual post; *G*, post braced with strut, and a tie which is anchored to a deadman; *H*, steel post with steel brace set in square concrete pier. (Corner or end posts are shaded.)

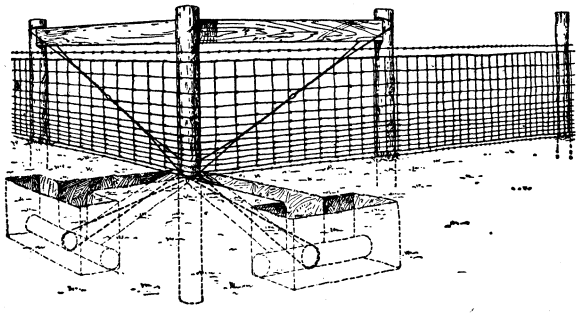


FIGURE 28.—A good corner-post bracing using deadmen anchors for brace wires.

The brace posts should not be spaced closer than 8 feet 3 inches. The following minimum sizes for wood posts, struts, and tie wires are recommended for the fence bracing assemblies shown in figure 27:

Single spans:

Corner post	6-inch diameter.
Brace post	5-inch diameter.
Strut	4-inch diameter.
Tie	2 double strands of No. 9-gage wire.

Double spans:

Corner post	5-inch diameter.
Each brace post	4-inch diameter.
Each strut	4-inch diameter.
Each tie	2 double strands of No. 9-gage wire.

Corner and brace posts should extend at least 3 feet 6 inches into the ground. Struts and ties should be securely fastened to the posts at the ground line and about 6 to 12 inches below the top of the posts. Each wire in the tie should be stapled to the posts with the staples driven diagonally across the grain to avoid splitting (fig. 29). Do not use a single plank for a strut. A 4- by 4-inch strut is much stronger than a 2- by 8-inch strut.

Corner and end assemblies of steel (fig. 30) require as much care

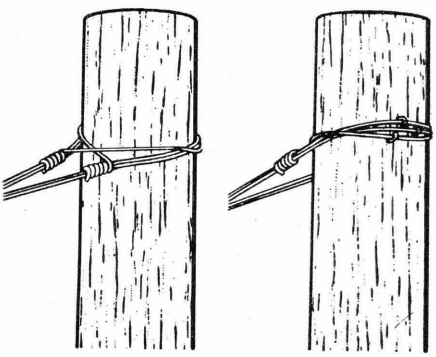


FIGURE 29.—A common method of fastening tie wires in bracing assemblies is to loop the wire around brace or corner posts and secure the loop with a short piece of wire in the manner illustrated (left, front view; right, back view). Tie wires are sometimes wrapped completely around the post.

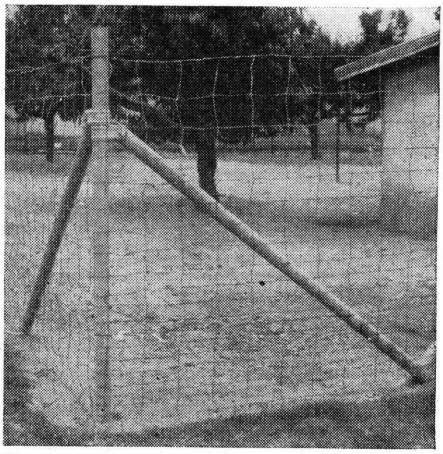


FIGURE 30.—A well-braced steel corner post in a poultry fence.

in installation as those of wood or concrete posts. Steel corner and end posts should be set in concrete, 3½ to 4 feet in the ground and should reach below the frostline. The hole for pouring the concrete should be about 18 inches square at the top and 20 inches square at the bottom. The post should be held in place in the center of the hole as the concrete is poured and the top leaned about 1 inch out of plumb away from the direction the fence is to be stretched. When the fence is stretched the post will be plumb.

Braces for steel posts must be attached to the end or corner post to determine the proper location of the brace pier. The pier should be 20 inches square at the bottom, 16 inches square at the top, and about 18 inches deep. The brace pier should enter the side of the pier about 6 inches belowground and should extend about 6 inches into the concrete. It will be necessary to cut a small slanting trench to place the lower end of the brace belowground.

Allow the concrete to harden for at least 4 days before stretching the fence.

On long stretches of fence it is desirable to install steel corner posts at about 40-rod intervals

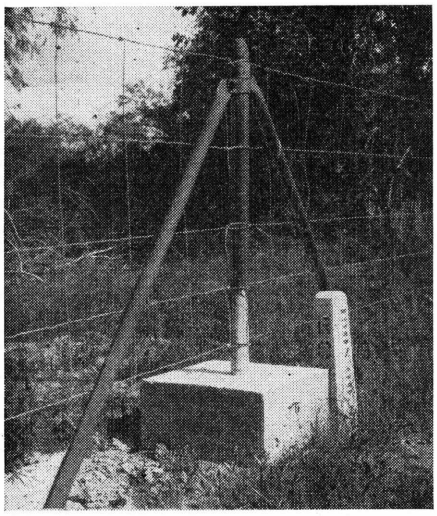


FIGURE 31.—A braced post in the fence line increases the life of a fence.

The posts should be set in concrete and have a brace on each side, parallel with the fence line. The fence should be securely attached to these intermediate brace posts. This type of brace post is illustrated in figure 31.

Post Anchors

The purpose of anchors, cleats, or bearing plates is threefold—to resist fence tension, impact of livestock, and frost heaving. Movement of wood brace posts may be resisted by the use of cleats on opposite sides of the post (fig. 27, *D*, *E*, and *F*). The lower cleats are effective in resisting frost action as long as the bolts or spikes hold. Anchorage for the tie wires may take the form of a deadman (fig. 28) or buried plate (fig. 32) bearing against undisturbed soil. The buried plate may be used in the corner-post hole, or a special hole may be dug. Steel posts are small in size and would be pushed over by live-

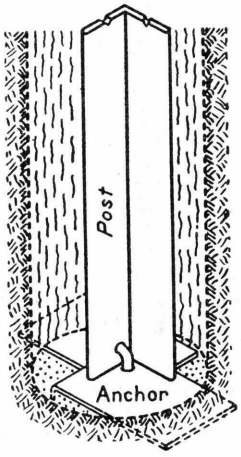


FIGURE 33.—A post anchor attached to the bottom of a steel post resists frost action.

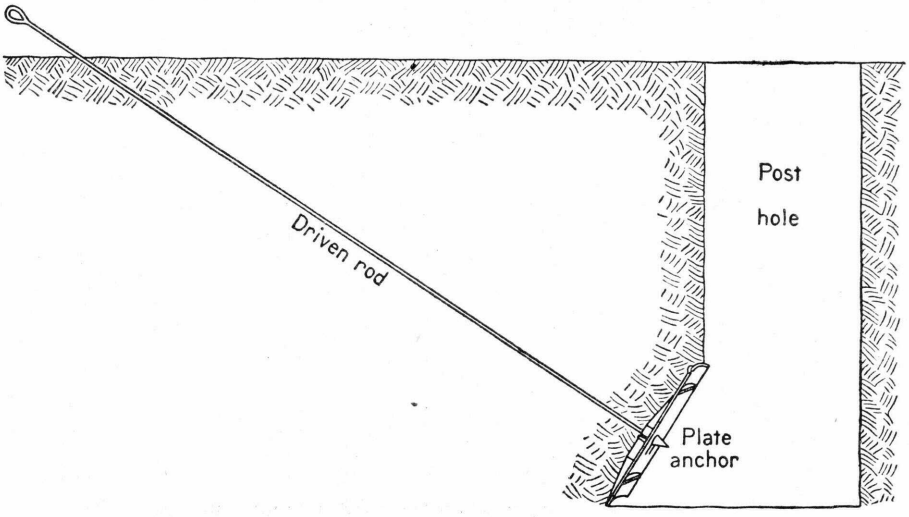


FIGURE 32.—A buried plate anchor, with a driven tie rod.

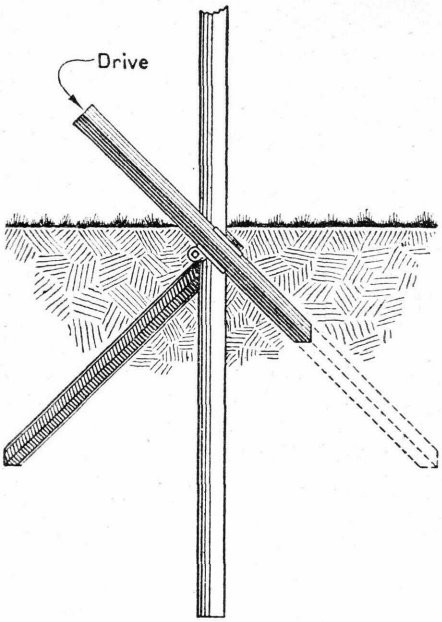


FIGURE 34.—A driven steel post anchored by steel angle irons driven into the ground.

stock if they were not anchored by plates. The anchor shown in figure 33 is attached to the bottom of a steel post. It expands and cuts into the soil as the post is revolved. Figure 34 shows an anchor which consists of two angle irons fastened to the post and driven below the surface of the soil.

Posts set in low spots or valleys are sometimes weighted (fig. 35) to offset the uplift due to wire tension. Cross cleats (fig. 36, *A*) or posts

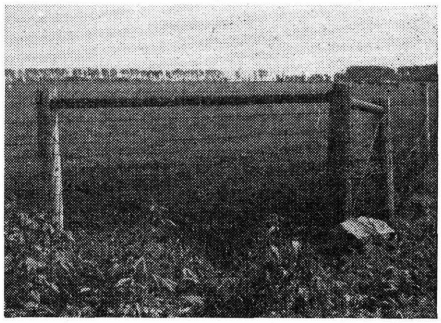


FIGURE 35.—A weighted corner post in a low, soft spot.

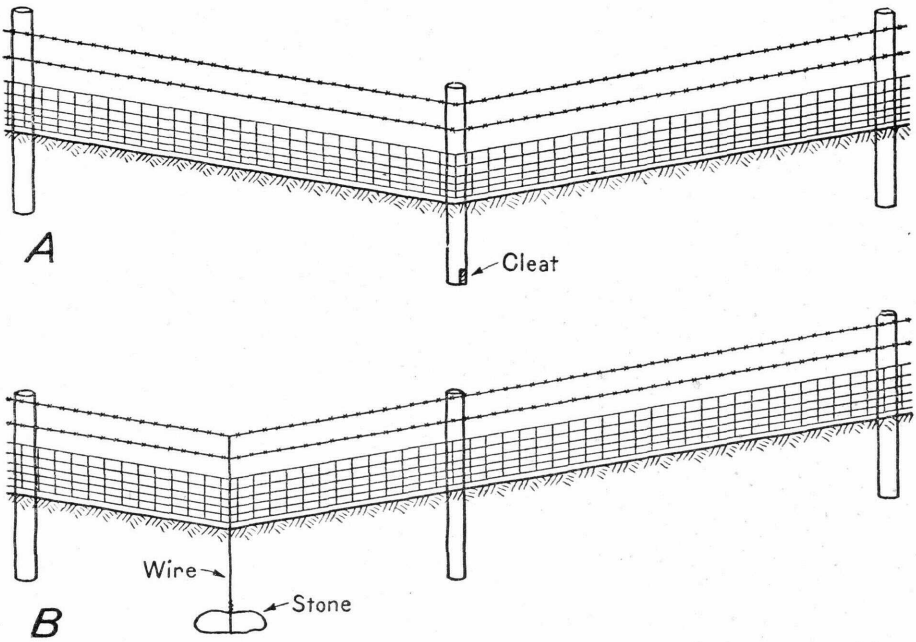


FIGURE 36.—Methods of offsetting upward lift of wire in depressions: *A*, A cleat on the post; *B*, stone or other heavy weight on the wire.

anchored in concrete are also used to offset the upward pull on posts. Fence wire is also sometimes weighted down at low spots between posts (fig. 36, *B*).

Splicing

The open loop should not be used in splicing a wire as the square corners formed in an open loop tend to cut, causing the wire to break more readily. The Western Union splice (fig. 37) is the longest-lasting type of splice. It can be made easily with the tool shown in figure 38, *A*. When the stays are 12 inches apart there is usually sufficient wire available to make a good splice between stays, but with stays 6 inches or less apart the kind of splice shown in figure 37 is used.

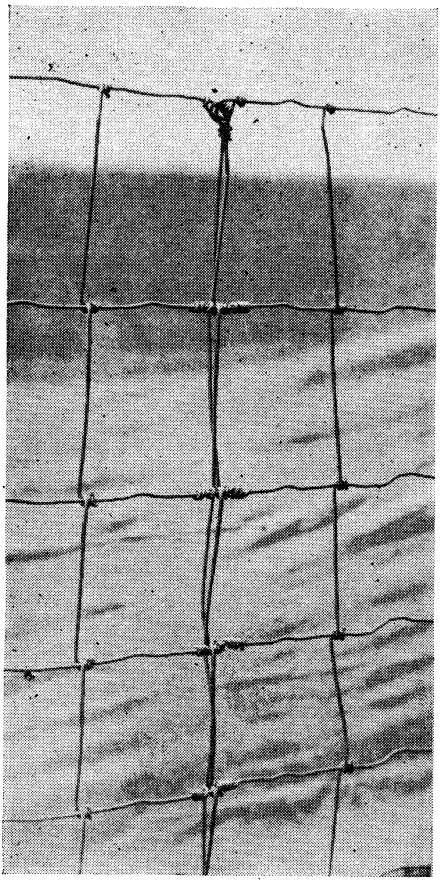


FIGURE 37.—The Western Union splice, suitable for woven wire, is easily made with a splicing tool.

Unrolling and Stretching Woven-Wire Fence

The first step in unrolling and stretching a woven-wire fence is to set the roll on end about 1 rod from the end or corner post. Unroll enough wire to reach to the post and make a wrap around it. Remove two or three stay wires, depending on the circumference of the post, and place the next stay wire against the edge of the post. Start with the center line wire and wrap the end of each line wire around the post and back onto the line wire, keeping the stay wire parallel with the post. About five

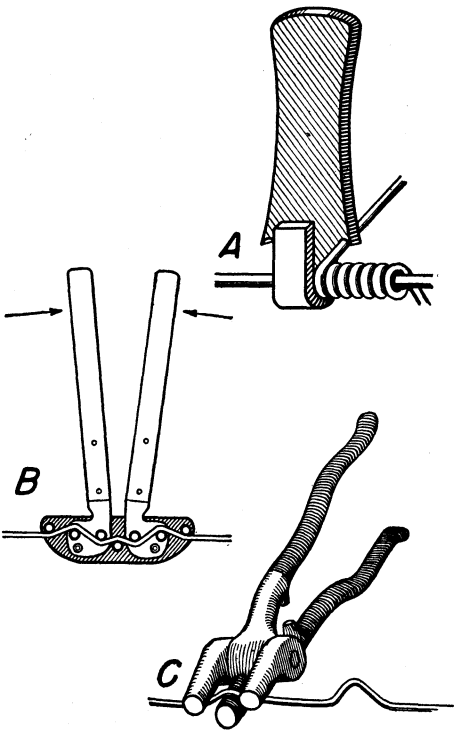


FIGURE 38.—Convenient fencing tools: *A*, Splicing tool; *B*, a double-crimp tool; and *C*, a single-crimp tool.

wraps around the line wire using a splicing tool will be satisfactory. Unroll the fence, keeping the bottom wire close to the post.

The wire should, if possible, be placed on the side of the posts next to the livestock; this prevents the staples from being pulled by the crowding of the livestock. Along highways the wire is usually nailed on the side next to the highway to permit stretching the wire without the interference of cross fences.

Stretching should not begin until all concrete is properly set and the posts firmly bedded. It is necessary to have a strong stretcher with dependable clamps which will not slip and damage the wire or injure the operator.

Stretchers for woven wire may have one or two jacks which may be attached to a convenient tree or a temporary post set for an anchor. Figure 39 shows a double-jack stretcher.

The single-jack stretcher (fig. 40) is satisfactory for narrow woven-wire fencing such as ordinary hog wire, but two should be used for fences of greater widths.

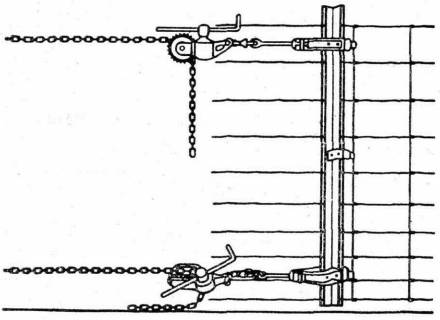


FIGURE 39.—A geared double-jack woven wire stretcher.

After the fence has been unrolled the clamp bar of the stretcher should be firmly fastened to the fence. It should be just as far from the end of the fence as possible and still within reach of the chains attached to the jacks. When all the bolts on the fence clamp have been securely tightened to prevent slippage the chains may be attached and tension applied with the jacks.

If a double-jack stretcher is used the jacks should be spaced to divide the number of line wires between

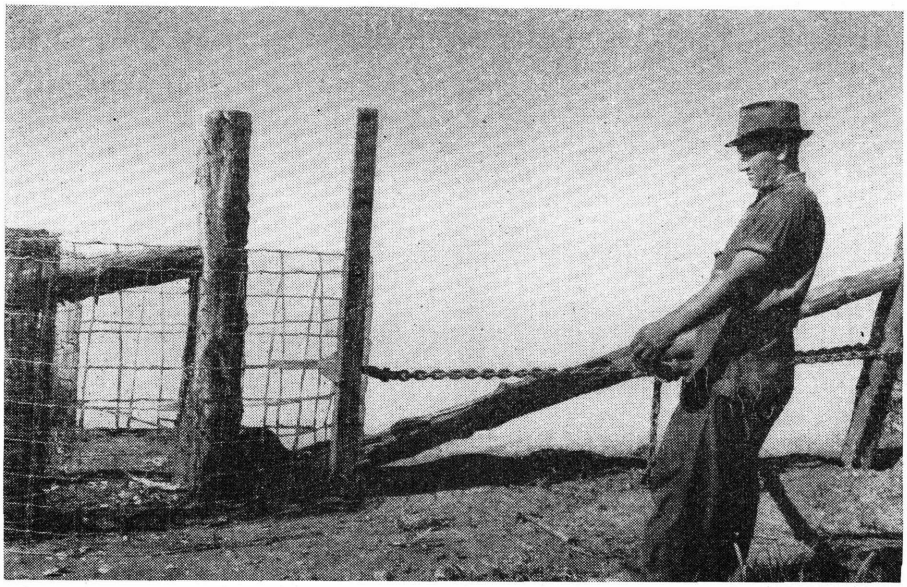


FIGURE 40.—Stretching a fence with a single-jack stretcher.

them. To insure uniform stretching with a single jack, the jack should be placed about 1 inch below the center of 26-inch fencing and about 4 inches below the center of 55-inch fencing.

The entire fence should be propped up against the posts with temporary stakes before stretching starts. The stakes should be set under the top wire and leaned slightly out and away from the direction of pull so they will continue to support the fence as it is tightened. When the fence must be stretched over a ridge two stakes should be used to support the fence and keep it from crowding down on the ground.

During the stretching operation the entire length of the fence should be inspected to be sure that it is riding free at all points. Usually the fence is considered properly stretched when the tension curves have been about half straightened out and when the fence is springy to the touch along the fence line.

Overstretching the fence can be more harmful than understretching. If the tension curves are straightened out too much there will be no provision left for keeping the fence tight as it expands and contracts due to temperature changes. If a tractor is used for stretching, special care should be used to keep the power under control at all times.

Before the fence is cut at the end where the stretcher is attached the fence should be fastened to the posts on the ridges and then in each of the depressions or low places. The hinge joints on woven-wire fence permit the wire to be pulled down into place in the low places without damaging the stay wires. When the fence is completely adjusted the line wires can be fastened one at a time, starting at the top. This method will prove much easier than attempting to pull the entire fence into place at one time, if it must be lowered any great distance. If the stretcher is left in place and the end of the roll of fence left uncut until the fence is in place on the ridges and in all of the low points, it is possible either to tighten or to loosen the tension on the fence as may be required.

Before cutting the end of the fence, measure the distance around the post and allow at least 5 inches for the wrap around the line wire. It is much easier to cut a little wire off the end if it is too long than to splice more on if it is too short. The last two stay wires should be removed before the line wires are attached to the post.

The slack in the fence between the stretcher clamp and the post is taken up by the use of a finishing stretcher tool. The center wire is fastened first, then the lower and upper wires. The fence builder can place one foot on the bottom wire to keep the fence in the proper place. The end stay wire should be parallel with the post to make a neat job. The fence splicing tool is used in wrapping the ends of the wires around the line wires.

Barbed wire is attached after the woven wire is stretched and stapled. Two men can unroll a reel of barbed wire by placing a rod through the center of the roll and letting it unreel as they walk down the fence line. One end of the barbed wire is attached to a gatepost or end post before the wire is unrolled. If more than one strand of barbed wire is to be placed above the woven wire it may be convenient to place the reels on an end-gate rod in the back of a farm truck or wagon. The reels will unwind as the truck is driven along the fence row. Special tractor attachments (fig. 41) for winding and unwinding barbed wire are available.

The barbed wire may be stretched with an ordinary block-and-tackle stretcher with a barbed-wire clamp attached. If no clamp is available, a loop may be made in the end of the barbed wire to hook onto the stretcher. At each end post, the

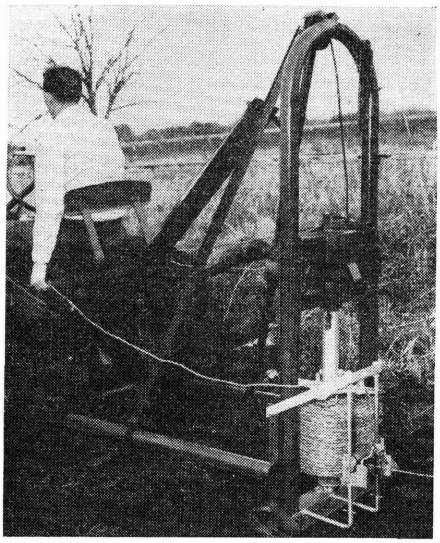


FIGURE 41.—Wire winder and unwinder attachment for farm tractors.

barbed wire should be anchored to the woven wire to keep it from slipping off the top of the post.

Proper spacing of the barbed wire above the woven wire is important. If 1 strand is used it should be placed not more than 4 inches above the woven wire and not more than 2 inches below the top of the post. This spacing will keep livestock from pushing through between the barbed wire and the woven wire and from rubbing against the top of the post.

Ordinarily not more than 1 or 2 rolls of wire are stretched at one time, and brace posts are set at the ends of each stretched section. Somewhat more skill is required to stretch longer lines, but lines up to one-half mile have been sucessfully handled. Fewer anchor posts will be needed and some labor can be saved if two rolls of wire are stretched at one time. This can be done by attaching the stretcher between the two ends that are to be spliced.

Wire is often fastened to corner posts and gateposts by means of pipes or bars and drawn taut by bolts (fig. 42). These connections

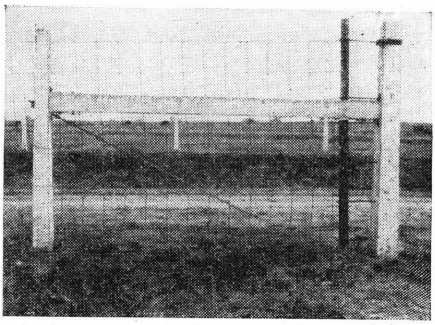


FIGURE 42.—The bolts which secure the wires to the gatepost in this fence can be adjusted to keep the tension on the wire constant. The brace wire is tightened by a turnbuckle, which is an improvement over a twisted-wire tie and permits adjustment of the tie.

also provide a means of increasing or decreasing wire tension according to seasonal demand, which is important in some sections. The crimpers shown in figure 38 can be used to remove slack from fence lines.

Wires should not be fastened directly to trees. If a tree is in a fence line, spikes may be driven into the tree and the fence wired to the spikes. Another method is to nail a 2-inch board to the trunk and fasten the fence to the board. Wire should not be stretched around a corner which changes the direction of the fence line more than 45°; it should be cut and wired to the post.

Contour Fencing

Contour farming introduced new problems in fencing. The Ohio Agricultural Experiment Station and the United States Soil Conservation Service are studying these problems in a research program. Tests are being made with woven-wire fence 47 inches high having No. 9 top and bottom wires and No. 11 filler wires. The fence has steel posts and 1 barbed wire 2 inches above the woven wire. A progress report issued after 3 years of research gives recommendations for building fence with the listed

materials. More recent tests indicate that the recommendations may also be applied to wire fences and wood posts. The recommendations are as follows:

1. Spacing line posts:

A. Stake out a smooth curve along the contour strip or terrace, spacing stakes 16½ feet apart.

B. Check the curvature of the fence line at different points to determine if posts will have to be spaced closer than 16½ feet. To check the curvature, select three consecutive stakes in any fence section and stretch a string between the first and third stakes. Measure the distance from the center stake to the string as illustrated in figure 43. Repeat

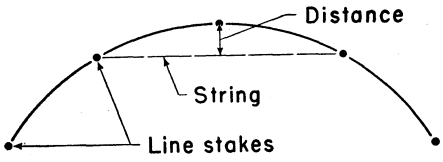


FIGURE 43.—Method of using line stakes and string to measure the curvature of contour fence lines.

this operation wherever the curvature appears to change appreciably. If this distance is 4 inches or less the fence posts can be put in at the stake spacing—16½ feet apart. If the distance from the center stake to the string is more than 4 inches the posts should be spaced closer. Spacing of posts where curvature of the fence line makes this measurement greater than 4 inches is given in table 10.

C. Replace the stakes at the spacing calculated by table 10 and check by eye to see that no single stake is out of the line of a smooth curve. Fence wire should then pull equally against each post.

2. Setting posts:

When driving or setting posts, lean the top out approximately 2 inches. When the wire is stretched the posts will tend to straighten up to a plumb position. Steel line posts should be 6½ feet long and have the usual brace plates.

3. Placing wire:

Always put wire on the outside of the curve so it pulls against the posts.

4. Stretching wire:

Fasten the end of the roll to the end post and roll the wire out on the ground along the fence line. Pull the wire up by hand until it clings against the fence posts. Attach the stretchers and apply only moderate tension, as a curved fence needs much less tension than a straight fence. The sharper the curve the less tension should be applied. When stretching the fence go along it several times and release it where it catches on the posts. On sharp curves it may be necessary to stretch in 10-rod sections. Otherwise, 20- to 40-rod stretches are satisfactory. When curvature changes materially it will be desirable to start one end of a roll at the sharpest point on the curve and apply the stretchers at the other end of the roll. When stretched this way, the wire at the sharpest part of the curve will have less tension than it would have if the stretchers were attached elsewhere.

TABLE 10.—*Recommended post spacings for curvature measurements of contour fence lines*

Measurement from center stake to string [1] (inches)	Recommended post spacing (feet)
4 or less	16½
4 to 5	15
5 to 6	14
6 to 8	12
8 to 14	10
14 to 20	8

[1] See text and figure 43 for method of measurement.

Construction of contour fences is not difficult; in fact, it is easier than building a straight fence over uneven ground. This is because a fence built on the contour has equal tension on the top and bottom wires. Wire in contour fences has no tendency to lift posts, whereas wire in a straight fence pulls upward on posts in places where the fence crosses low spots.

Lightning Protection

Much livestock is killed by lightning carried along a fence. In areas subject to frequent thunderstorms it is an excellent practice to ground the fence line about every 10 rods. Grounding is especially important in fence corners, where cattle are inclined to collect. Grounding a wire fence in the vicinity of high-voltage powerlines

is a safety precaution that should not be neglected. When steel posts are used the fence is automatically grounded. The best way to ground a fence on wood posts is to insert steel posts or pipes at intervals. The single wire sometimes stapled vertically to the post is short-lived and generally useless as a lightning conductor.

Gates and Entrances

The location of the gate is more important than its construction, since it must be convenient to fields or barn lot, and safe if next to a highway. The choice of a gate and its construction depend upon its use.

The entrance to a roadway must be well drained to prevent erosion and to permit all-weather use. Approaches should have curves with an inner radius of not less than 30 feet and up to 40 feet where a tractor and trailer are used. Square turns with a small turning space may be satisfactory for horse-drawn vehicles, but easy curves are required for motor vehicles (fig. 44). Driving straight ahead is preferable to backing and turning.

The importance of a safe entrance off a main highway increases as the speed of travel on the highway increases. Figure 45 shows a dangerous farm entrance; the highway traffic is hidden from the driver's view by trees. A slow-moving vehicle or farm implement coming out of such an entrance may block the highway and endanger both farmer and motorist. Figure 46 shows a field entrance with an offset extending inward beyond the main fence line. Such an offset must extend back from the highway far enough to provide standing room for any implement likely to be used. A level entrance or one on a gentle slope is far safer than one located on a hillside.

A well-designed entrance adds to the attractiveness of a farmstead and can advertise the farm and farm products. Stone, brick, or concrete, or combinations of these materials, may be used for entrances. The choice of design depends in part upon availability of material and labor. Swinging gates are usually used for farm entrances and

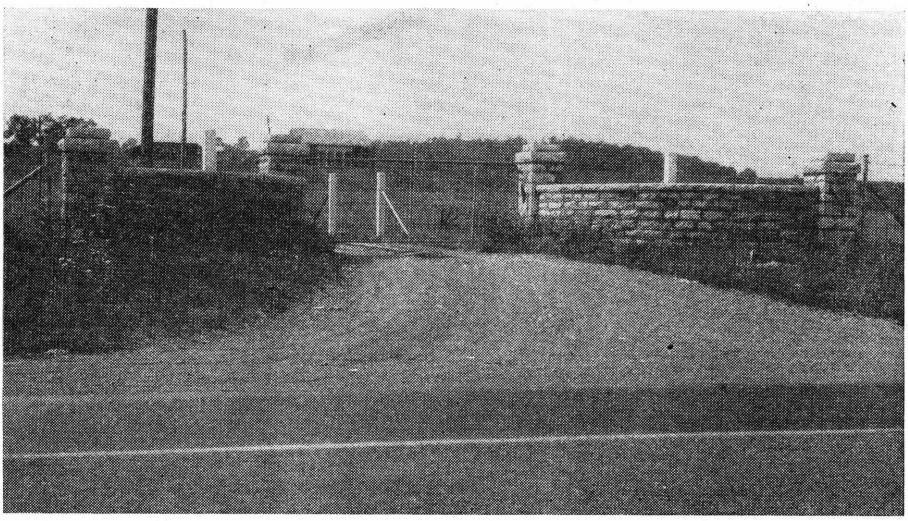


FIGURE 44.—An attractive farm entrance 30 or more feet from the highway.

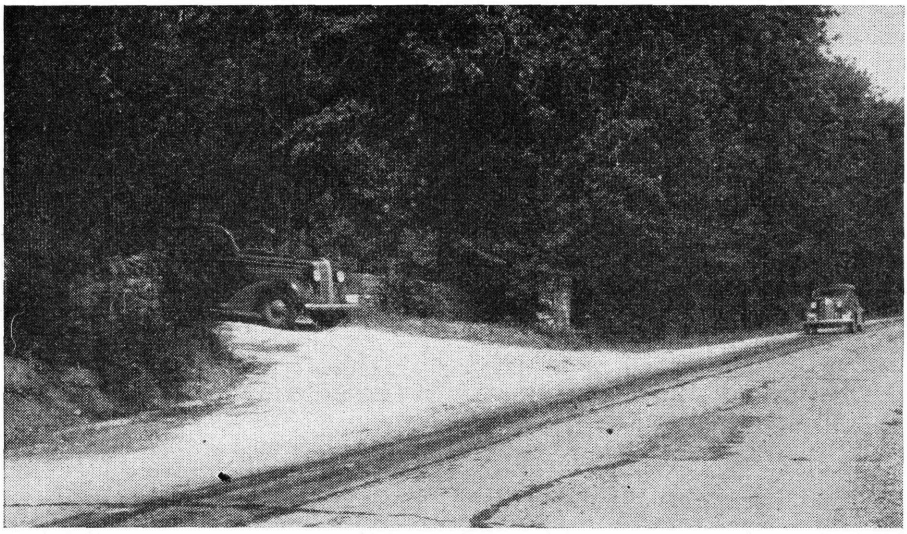


FIGURE 45.—A hidden farm entrance is dangerous to farmer and traveler.

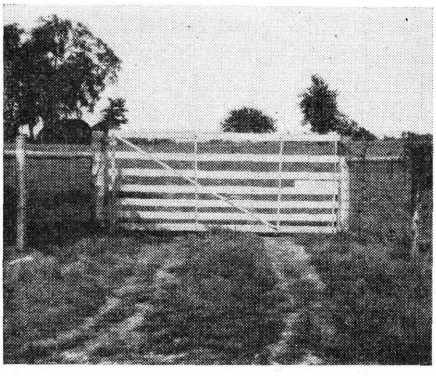


FIGURE 46.—Gates which are offset from the main fence line provide safe entrances to fields and pastures.

they should be built to swing both ways.

A few hours spent in the construction and proper hanging of a gate will save time and much aggravation. A gate that drags on the ground is difficult to operate. Lightweight gates are easier to operate than heavy gates, but gates of too light construction are easily broken by livestock and vehicles. The common heights of gates are 48, 50, and 55 inches. Steel gates often weigh less than 100 pounds; wood gates may weigh 200 pounds or more. Barnyard and paddock gates must be built strong enough to withstand frequent shocks from livestock confined in small enclosures. Gates for feedlots, corrals, and barnyards usually swing into the enclosure when opened. A single swinging gate is more convenient to operate than a double gate.

Gate widths should be determined by the kind and number of livestock and the kind and width of vehicles to be driven through the gate. The common widths are 8, 10, 12, 14, and 16 feet. Most implements have a track width of 8 feet or more, and a gate wider than the track width is required when an implement must turn and enter at the same time. Large combines or loaded hay wagons require gates 14 to 16 feet wide for convenient entrance. Figures 47 to 55 illustrate gate designs for different locations and uses.

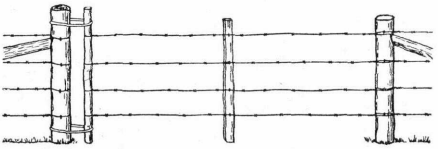


FIGURE 47.—A cheap gate can be made of 3 or 4 strands of wire fastened to a wood or steel bar and held by loops of wire at the gatepost.

FIGURE 48.—In timbered sections pole gates may be economically used for fields entered infrequently.

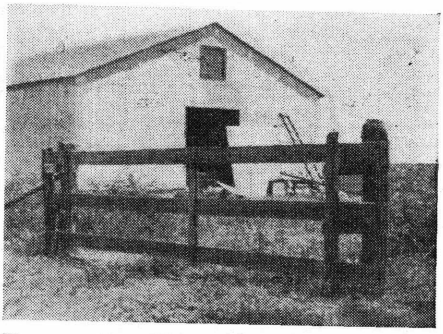


FIGURE 49.—Cheap, three-board sliding gates which do not have hinges may be used for field entrances or other entrances where there is little hard use.

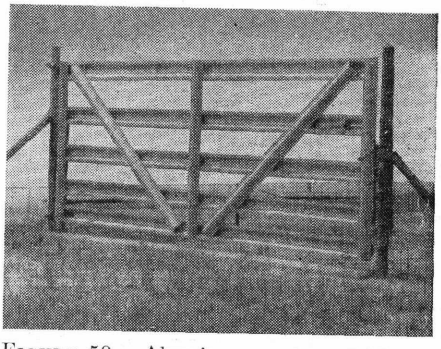


FIGURE 50.—Aluminum gates which are strong and light in weight can be purchased in many designs and sizes.

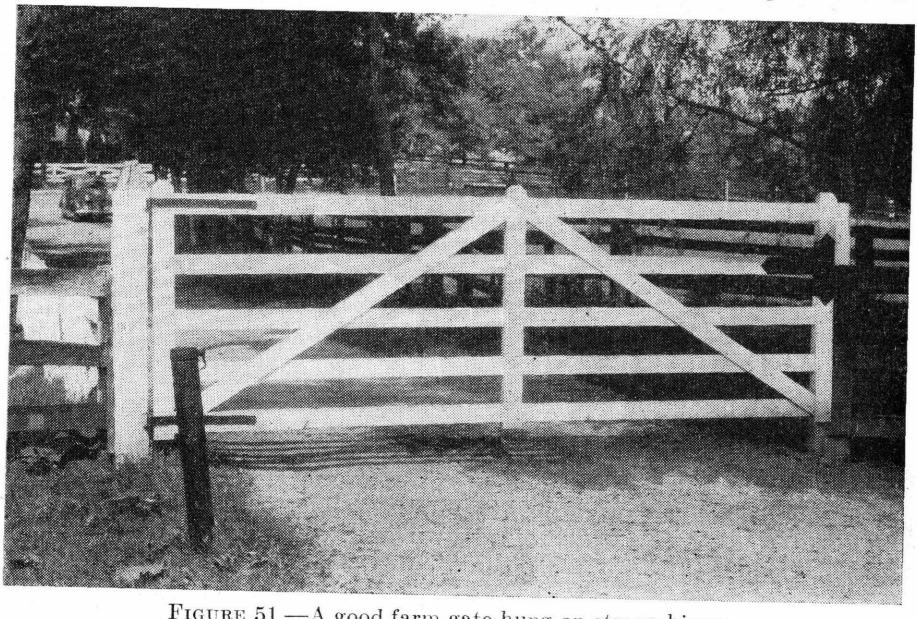


FIGURE 51.—A good farm gate hung on strong hinges.

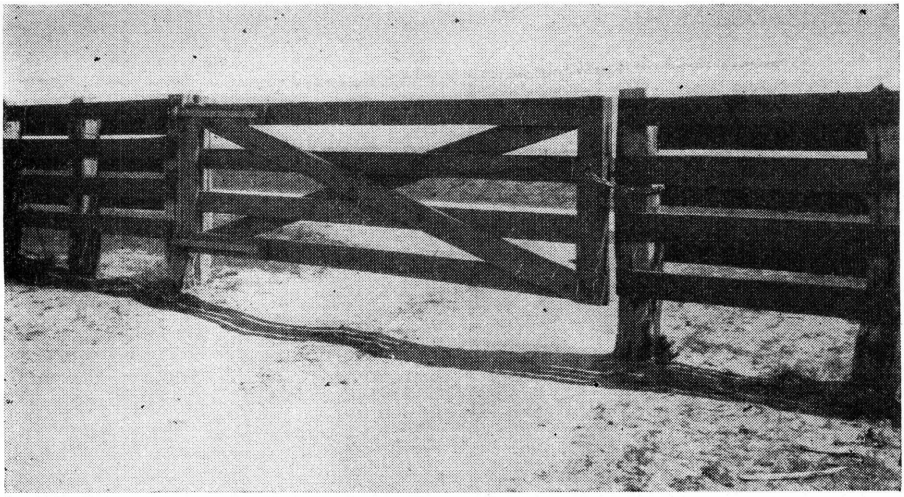


FIGURE 52.—When large herds of livestock are crowded through a gate the fence adjacent to the gate is subject to great strain. Planks nailed to the gateposts and fence posts on both sides of the gate will keep stock from crowding against the wire.

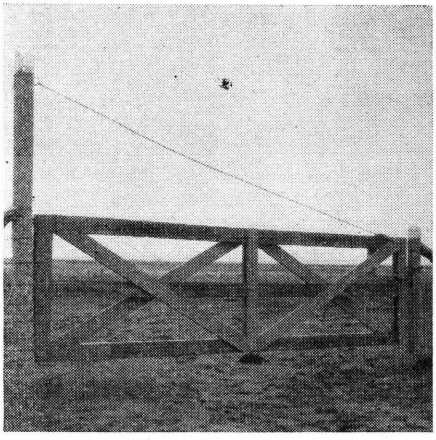


FIGURE 53.—A wire or rod from the gatepost to the swinging end of the gate takes some strain off the hinges and reduces sagging. Cross braces give added strength to the gate.

Bracing Gates

The object of bracing a gate is to prevent sagging and racking. A well-braced gate is easy to operate and is durable. Braces in wooden gates should be held secure with bolts and well-clinched galvanized nails. If bolts or nails slip, the gate is weakened. A wheel attached caster-fashion to the swinging end of long gates makes them easy to handle and reduces sagging. However, wheels work well only on level ground. Various types of braces for gates are illustrated in figures 51 to 55.

Cattle Guards and Automatic Gates

Cattle guards and automatic gates make it possible to cross fence lines in an automobile or truck without the driver or passengers getting out of the vehicle. Cattle guards (figs. 56 and 57) may be built strong enough for trucks by using discarded steel rails or small I-beams for the grating. Pipes varying in size from 2 to 3 inches in diameter may be used by spacing them from 6 to 9 inches apart, center to center. Spacing the crosspieces too far apart causes severe jolting and may cause damage to the grate supports when loaded trucks cross the gate. The grated area is from 4 to 6 feet wide and forms an effective barrier for large livestock. Goats and sheep will walk through if a smooth path 2 inches or more in width is provided. Wire wings (fig. 56) or metal wings (fig. 57) will keep goats

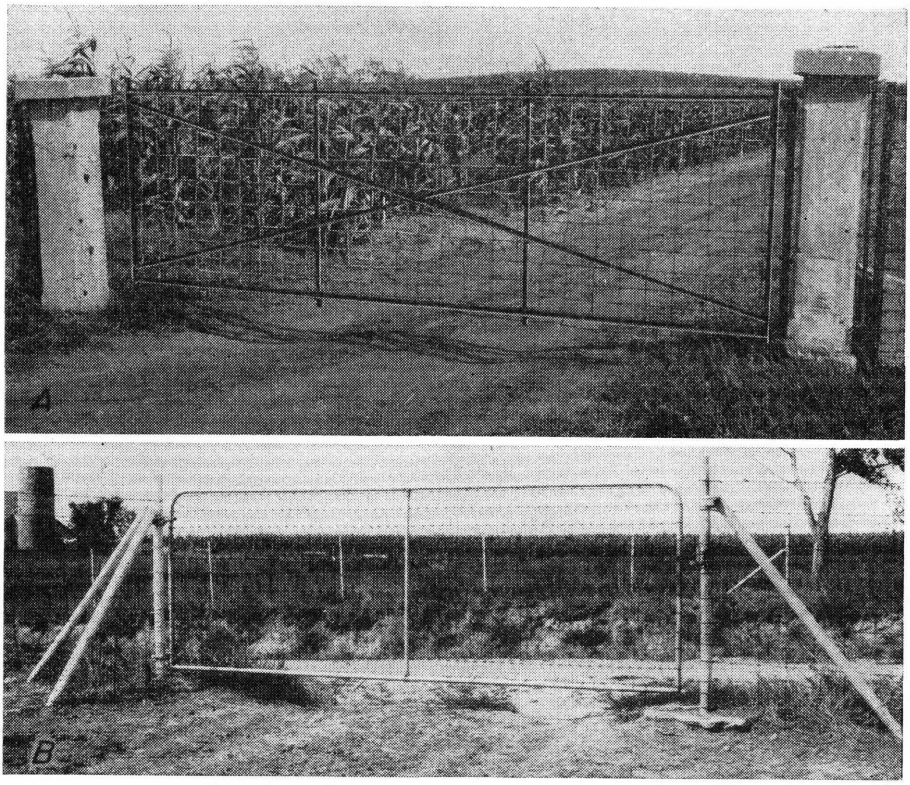


FIGURE 54.—*A*, A steel gate with frame and cross braces of light angle iron; *B*, a steel gate with a pipe frame and a wire tie. Wire ties and cross braces reduce distortion in steel gates.

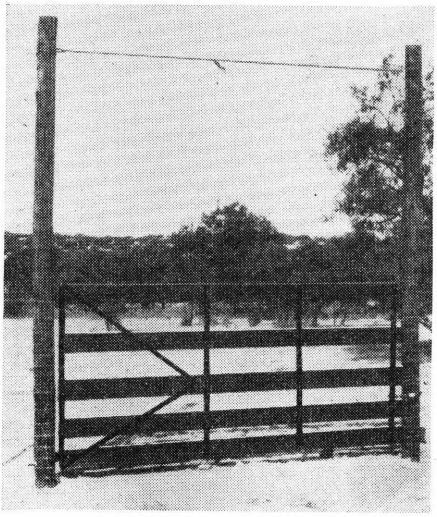


FIGURE 55.—A simple board gate can be made of boards and angle-iron braces. Gateposts can be prevented from spreading by overhead tie wires.

and sheep from going around the ends of a pit. U-shaped coverings on the timbers are obstacles which will keep goats from crossing on the grate supports.

A pit 12 to 18 inches deep is part of the guard. The drainage of this pit is important. Kerosene, crankcase oil, or chemicals may be used in the pit to control mosquitos and weeds. The bars should be removable so the pit may be cleaned occasionally. Where pits are too objectionable, the cattle guard may be built 12 to 18 inches above the road level and approach ramps provided on each side.

Automatic gates for automobiles or other vehicles are made in three forms—swinging, tilting, and sliding. They may be operated by a pull rod, as shown in figure 58, or by a lever or cam operated by a car

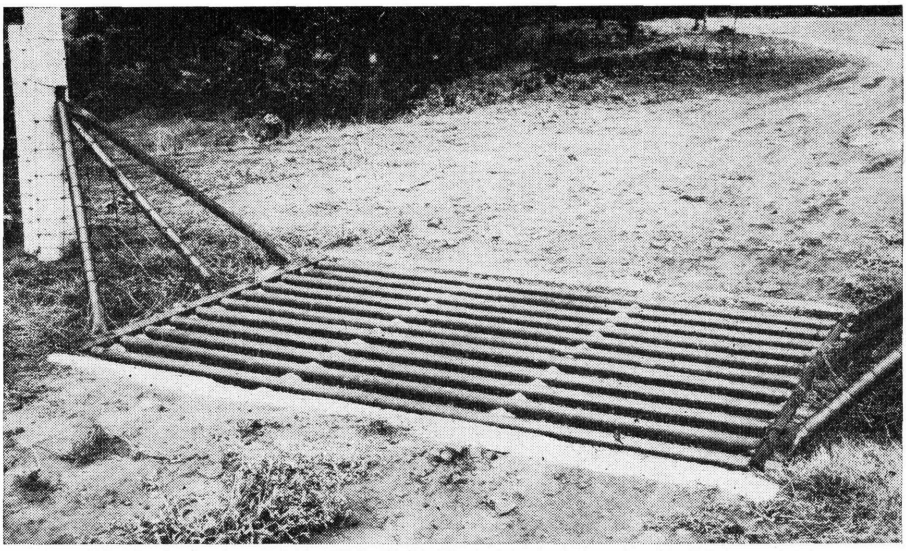


FIGURE 56.—A cattle guard with a grating of iron pipe. The pipes may be removed to clean the pit.

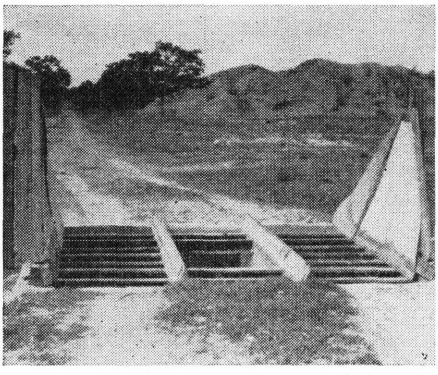


FIGURE 57.—A goat-proof cattle guard. The central opening permits cleaning and discourages goats and sheep from crossing.

or truck. The bumper, or swinging, gate shown in figure 59 may be pushed open by cars. Any form of vehicle or livestock may pass through this gate when it is open, whereas a second gate for livestock is necessary when a cattle guard is used. Such gates swing from a central support of chains or cable. However, car and truck bodies, and even the gate itself, may be damaged when the gate is carelessly or unskillfully operated.

Balanced or weighted gates are more easily operated and require less substantial gateposts than conventional gates. Figure 60 shows a balanced gate which can be adjusted to permit the passage of small livestock while stopping larger stock, and can also be adjusted to stay clear of snow. It swings on hinges like conventional gates.

Designs for cattle guards and some types of gates may be obtained from the Extension Agricultural Engineer at many State agricultural colleges.

Gateposts and Hardware

Gateposts should be substantial, usually not less than 10 or 12 inches in diameter and should be set in the ground at least 4 feet and firmly anchored. Gateposts that creep and spread apart cause much difficulty with gate latches. Frost action, gate weight, and fence tension all combine to produce movement of gateposts. Gateposts may be permanently tied together, as in figure 55, to prevent creeping. When gateposts are set they should be tied together until they are

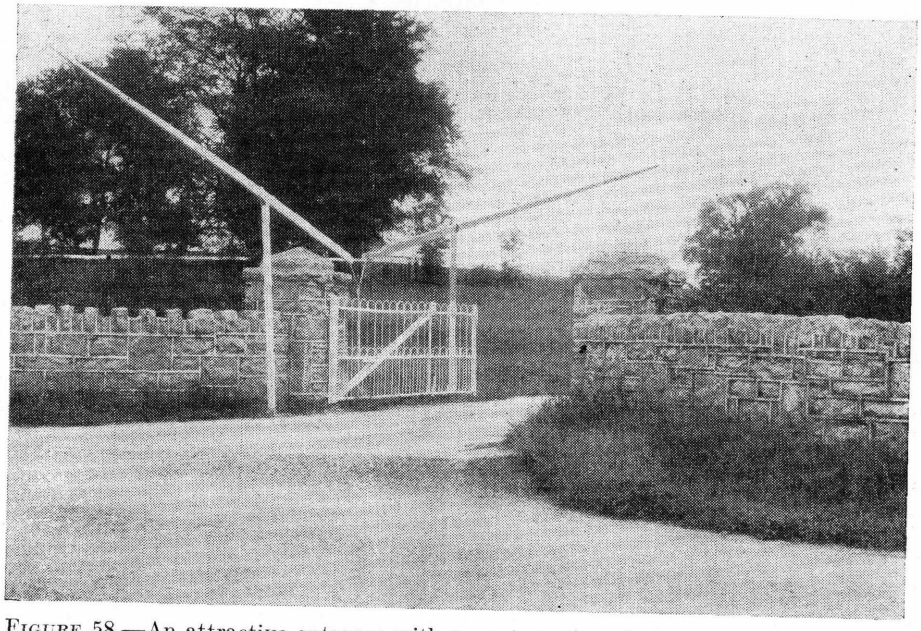


FIGURE 58.—An attractive entrance with an automatic swinging gate which is easily operated from an automobile by a pull rod.

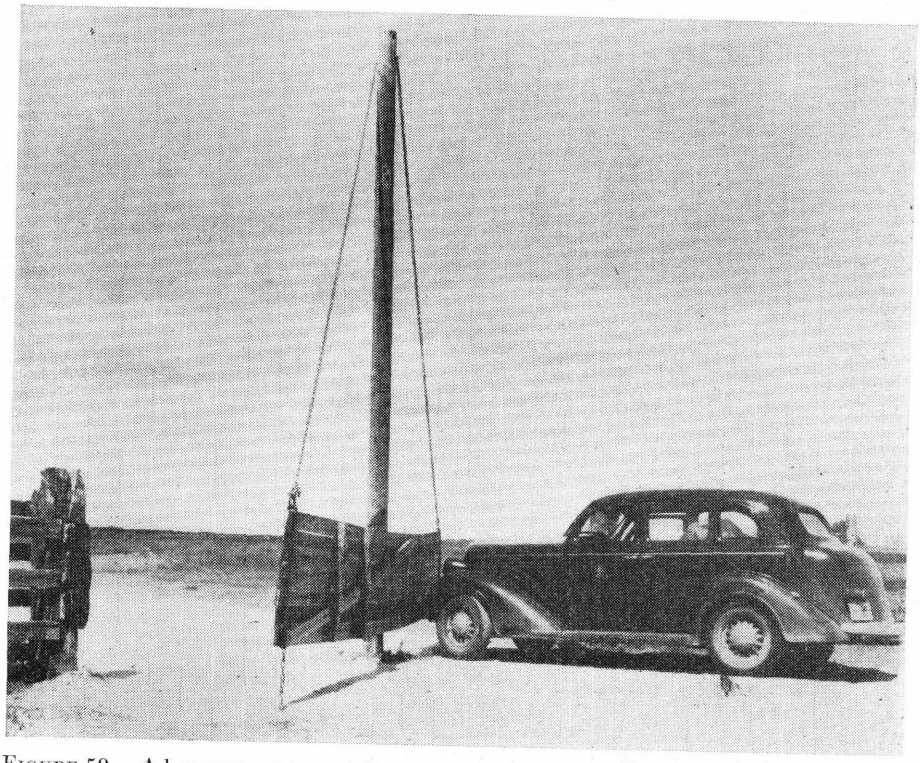


FIGURE 59.—A bumper gate partially open; it may be locked open for the free passage of cattle or trucks. The gate swings from a chain or cable and closes by gravity.

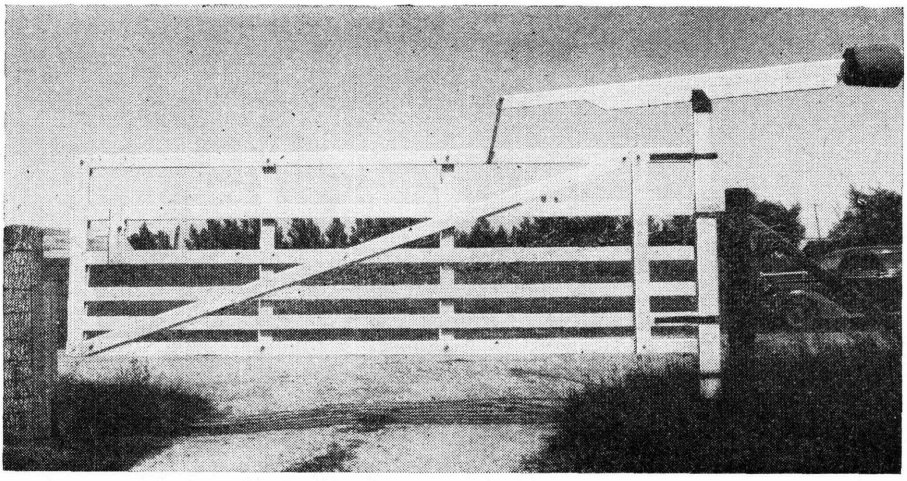


FIGURE 60.—A balanced gate shown in the raised position.

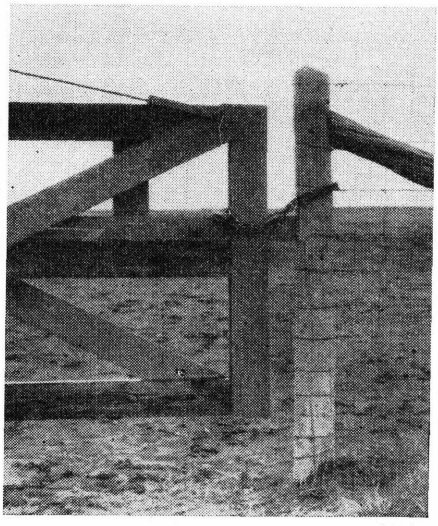


FIGURE 61.—Stock cannot slide open the notched latch on this gate, and the chain and padlock are protection against theft of stock.

firmly set. The chain used in figure 61 insures a safe lock and permits the use of a padlock when desired.

The use of lag screws for hinge anchors is unsatisfactory, particularly with heavy gates. Water causes rotting and weakening of the wood, permitting screws to pull out. Hook bolts extending through the post are more satisfactory. Unauthorized entrance by lifting the gate from its hinges may be prevented by turning the top hook down. The strap hinges shown in figure 52 are extra long, and all sharp edges are flattened and beveled to avoid injury to livestock. In many cases a gate latch in the form of a hook and bolt may be made to support the outer end of the gate and thus reduce the strain on gateposts. A supporting block under the corner of the gate may also be used.

Cattle Passes

Modern high-speed roads are frequently built through a farm so that fields are isolated from buildings. This is a definite hazard to stock crossing the highway and to the attendant driving them, and frequently to the drivers of automobiles. The hazard can be eliminated by the use of cattle passes. Cattle passes under highways should be either 4 feet wide, or 8 to 10 feet wide. A 4-foot width prevents horses and cows from turning around, whereas a width between 4 and 6 feet is not enough for 2 animals to pass abreast or to prevent

the stock from being wedged between the walls should they attempt to turn back. A passage 8 to 10 feet wide permits the passage of a truck or of several animals abreast. A height of 6 feet should be the minimum for an underpass, and if it is to be used for vehicles the required clearance will depend on the type of vehicles to be passed. The bottom of the underpass should be sloped toward one end so that quagmires will not result from drainage or storms. Culverts may be built large enough to use as cattle underpasses. If built solely for cattle, passes are expensive, but may be justified for registered stock.

Crossings under or over public highways must generally be designed and built by highway engineers. Crossings can be provided more economically if built as the highway is constructed. They should be arranged for at the time of selling or giving the right-of-way, or before construction is begun for improving an existing highway. Underpasses must provide safety for the heaviest vehicle permitted on the highway.

Lanes

Lanes may be fenced off to provide safe passage for livestock from one part of the farm to another. The practicality of a lane is determined by its cost, the labor it will save, the needed protection for livestock, the shape of the farm, and the position of fields. The width of pasture lanes may vary from 20 to 50 feet. Loss of crop acreage, value of land, amount of livestock, and the need for such a lane will determine the proper width. Lanes less than a rod wide are difficult to keep in grass if used regularly.

Floodgates

Where fences cross ditches, gullies, and streams, special provision is needed to keep animals from crawling or swimming under the fence. It is also important at such places to prevent debris from forming a dam that might wash out the fence or cause water to back up and flood fields or other property. Various types of floodgates or pushouts are in use, one form of which is illustrated in figure 62.

Two very important requirements for floodgates are strong anchor posts on each bank and prevention of bank erosion. The floodgate should be cleared of debris after each flood so it will close. This is especially important where the stream flows through wooded land.

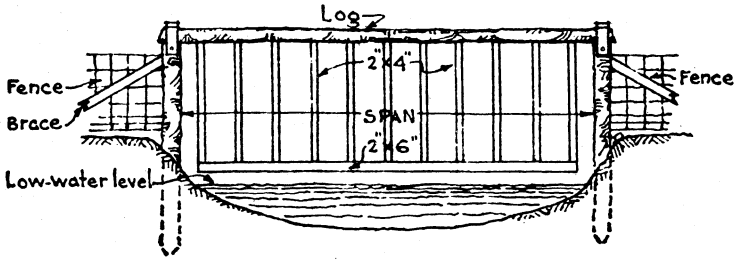


FIGURE 62.—A typical floodgate for fencing ditches, streams, and gullies.

Maintenance

Maintenance is an important item to consider when the decision is being made on the kind of fence to build. Repairs and the cost of cleaning fence rows and keeping down weeds are included in the total cost of a fence. Cheap materials and cheap construction lead to high maintenance costs and a short-lived fence. The annual depreciation of fences lasting 20 years is only 5 percent, and the annual depreciation of fences lasting 15 years is 6.6 percent. For permanent fences good grades of material and good workmanship are cheapest in the long run.

Spring and fall are the most favorable seasons to inspect fences, drive down posts heaved by winter frosts, and repair, relocate, or remove fences. In moving a fence line the removal and re-use of wire is often a problem. Removal of lower wires first will usually result in less tangling of the wire. Old barbed wire may be rolled on old barrels. Disposal of wire that is unsatisfactory for re-use is also a problem. It may be placed in ditches or fastened to stakes to decrease soil erosion, but it should not be left in fence corners or any place where it may be a menace to livestock.

Old fence posts often cannot be re-used in relocating fence lines because of the difficulty of pulling sound posts. Post pullers may be purchased or pullers similar to the ones shown in figure 63 may be made. A tractor or a team of horses are often used with the chain-and-pole type of puller shown in figure 63, *C*.

Soil along highways sometimes erodes and slides into the ditch, making it necessary to shift the fence line. The cooperation of the highway authorities in sodding or planting vines or shrubs to reduce soil washing will aid in some of these cases. The use of tile in place of ditches may also help. In other cases there appears to be no solution except to move the fence back from the property line.

It is always helpful to have the highway fence lines seeded to grass or hay crops which keep down weeds and can be mowed easily. Careless smokers often start fires which cause heavy losses of fences and crops. Many farmers plow a strip several furrows wide along the fence line as a fireguard.

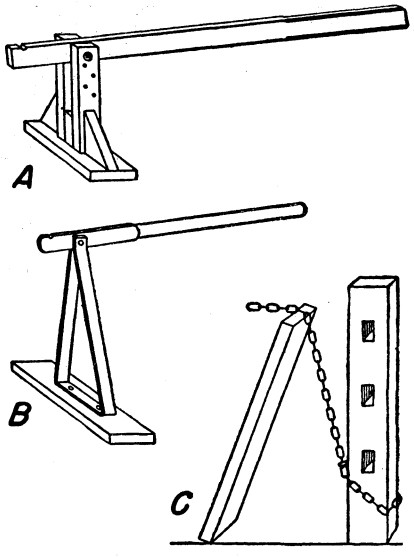


FIGURE 63.—Devices for pulling fence posts: *A*, A homemade wood-frame post puller; *B*, a puller made of steel; *C*, a chain and pole to pull a post with a team or tractor.

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